AUG 18 1921
Engineering Library

Telephony

THE AMERICAN TELEPHONE JOURNAL

PUBLISHED EVERY WEEK
BY TELEPHONY PUBLISHING CORP.
116 S. MICHIGAN AVE., CHICAGO, ILL.

AUGUST 13, 1921. [VOL. 81. NO. 7.]
Entered as second-class matter Sept. 4, 1908, at the post office at Chicago, Ill., under act of March 3, 1879.

SINGLE COPIES, 10 CENTS
YEARLY, U. S. A., $3; CANADA, $4
ALL OTHER COUNTRIES, $5

ANACONDA
Copper Telephone Wire
Tie Wires
543 Conway Bldg.
CHICAGO

American Steel & Wire Co.'s
W & M
Telephone
Telegraph
Wire
Strand —STEEL WIRE
Pole Steps
Descriptive literature—free
American Steel & Wire Company
Chicago
New York

EVERSTICK ANCHORS
lead the world in anchor sales.
WHY?
EVERSTICK Anchor Co.
St. Louis, Mo. U. S. A.

CEDAR POLES
Wire or write for delivered prices
NATIONAL POLE CO.
ESCANABA :: :: MICH.
220 Broadway, New York
1344 Summit Street, Toledo, Ohio
Rialto Building, San Francisco

CABLE RACKS
Hot galvanized Hubbard Cable Racks are in use throughout the country. Standard with A. T. & T. Co.
Ask your jobber
HUBBARD & CO.
PITTSBURGH, PA.
The Hardware makes the Line; Hubbard makes the Hardware.

TRADE MARK Red Devil Tools
Red Devil
Pliers
for linemen and electricians

No one gives a plier harder service than perhaps a lineman or electrician. Their tools of the trade are almost daily subjected to wear and tear, if not abuses, and there's small chance for a poor tool to survive.

The "Red Devil" line of drop-forged pliers is essentially designed to give faithful, dependable service throughout a long life Cutting edges *cut* and stay sharp; jaws cross-checked to grip firmly; handles scientifically designed to fit the hand and increase the leverage power. *Ask the man who knows tools.*

"Red Devil" Pliers—made in 100 styles—one quality; one for every need.

The "Red Devil" Electrical Tool Booklet is yours for the asking.

SMITH & HEMENWAY CO., Inc.
87 Coit St. IRVINGTON, N. J.

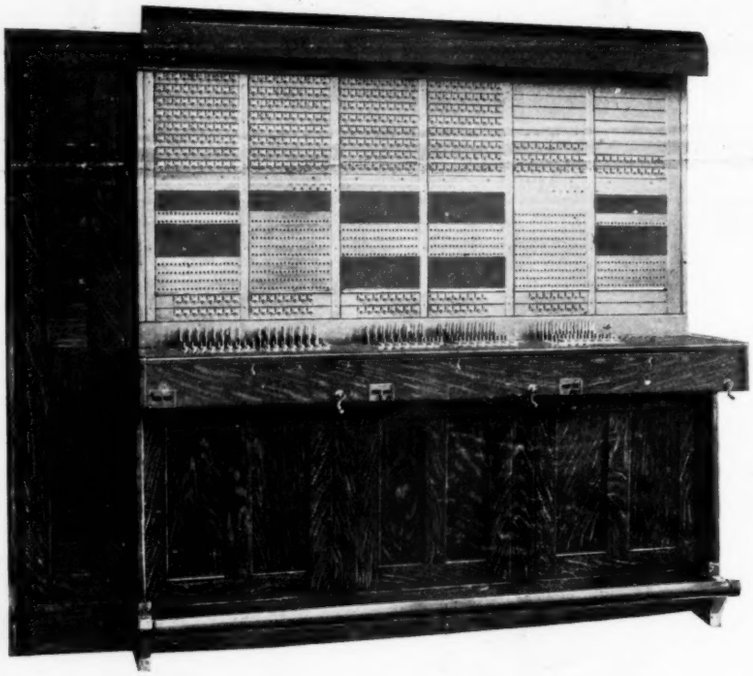
FORT WAYNE PRINTING COMPANY
FORT WAYNE, IND.
Printers and Blank Book Manufacturers
Write for Samples and Prices on I. C. C. Forms
Ours Are the Best

Telephone Cables
ALL SIZES AND CAPACITIES
Hard Drawn Copper Telephone Wire
Galvanized Iron Telephone Wire
Siemens-Martin and High Strength Strands
AMERICAN ELECTRICAL WORKS
PHILLIPSDALE, R. I.
CHICAGO—111 W. Adams St.
CINCINNATI—Traction Building
NEW YORK—233 Broadway
BOSTON—176 Federal St.

MATTHEWS SCRULIX ANCHORS
Can be used under more varied conditions than any other

208 page hand book on request
W. N. Matthews & Bro., Inc.
St. Louis, Mo.

Improve Your Service - - Increase Your Revenue



No. 5A Electrically Restored Drop

The Leich Electrically restored drop is the same as the mechanically restored drop except that the shutter is restored electrically by means of a restoring coil. Simple—well made—efficient.

Lower Your Maintenance and Operating Expense

Since the advent of the LEICH MAGNETO MULTIPLE SWITCHBOARD with Electrically Restored Drops it is no longer advisable to convert an exchange of less than 1000 lines to Common Battery.

All reliable Telephone Engineers agree that Local Battery Transmission is superior to Common Battery Transmission and reports from Public Service Commissions show that the cost of maintaining and operating a Magneto Exchange is considerably lower than cost of maintaining and operating a Common Battery Exchange.

The LEICH Magneto Multiple Switchboard will greatly reduce your present operating costs and enable you to give the best service obtainable without sacrificing your present telephone equipment or increasing your present maintenance force.

In most places where our Magneto Multiple Switchboards are installed, the Managers seriously considered Common Battery but in every place they are well pleased and find that they made no mistake by putting in the Leich Magneto Multiple switchboard.

If your are confronted with the problem of increasing your revenue and at the same time reducing your expenses it will pay you to investigate fully the Leich Magneto Multiple Switchboard with electrically restored drops.

LEICH ELECTRIC CO.

Telephones, Switchboards, Accessories

GENOA, ILLINOIS

DISTRIBUTORS

ELECTRIC APPLIANCE COMPANY
Chicago, Dallas, San Francisco, New Orleans

ST. PAUL ELECTRIC CO.
St. Paul, Minn.

POST GLOVER ELECTRIC CO.
Cincinnati, Ohio

TELEPHONE & ELECTRIC SUPPLY CO.
Spokane, Wash.

B-R ELECTRIC COMPANY
Kansas City, Mo.

Telephony.

THE AMERICAN TELEPHONE JOURNAL

Comprising Telephony, American Telephone Journal, Telephone Weekly, Telephone Magazine, Telephone Securities, The Telephone, Sound Waves.

PUBLISHED WEEKLY BY TELEPHONY PUBLISHING CORP.
116 S. Michigan Ave., Chicago

H. D. FARGO, President and Treasurer.
G. M. ALLEN, Mgr., Copy Department.
S. R. EDWARDS, Editor and Secretary.
J. R. HASTIE, Vice-President and Advertising Manager
S. J. BORCHERS, Assistant Advertising Manager.

Entered as second-class matter September 4, 1908, at the post office at Chicago, Ill., under act of March 3, 1879.

Volume 81
Number 7

CHICAGO SATURDAY, AUGUST 13, 1921

Subscription—10 Cents a Copy
$3 a Year U. S., Cuba and Mexico
$4 Canada, $5 Other Countries

CURRENT OPINIONS AND COMMENTS

Attention has frequently been called in these columns to the necessity of telephone companies and other utilities keeping the public posted about their affairs.

Taking the people of the community into their confidence and laying the facts before the people is a very important preliminary to a successful move for higher service rates. The frequent occurrence of "subscribers' strikes" recently especially emphasizes this at the present time.

"One of the great handicaps in the operation of a successful public utility is the lack of information on the part of the public served," was one of the statements in a recent address by James A. Perry, president of the National Association of Railway & Utilities Commissioners. All members of rate-fixing commissions soon learn that back of most cases of opposition on the part of the public is ignorance of the burdens and difficulties of the service companies. Most of this opposition disappears when the facts show that the utility needs more revenue in order to give good service.

The utilities should furnish this information to their patrons—not only just prior to the filling of a rate application, but regularly throughout the year. The service company which, by the right kind of publicity, keeps the public acquainted with its affairs from month to month, is surely accumulating a stock of good will which will stand it in good stead when the time comes to ask the commission for an crease in rates.

The manager of a telephone company in a Middle-Western state, who has a "subscribers' strike" on his hands, writes TELEPHONY of his troubles in a way which shows forcibly the value of establishing and maintaining friendly relations with the community served. His company operates two exchanges, and lost money during the war period on the rates then in effect. The manager took the case to the state commission and, after two exhaustive hearings, was awarded an increase in rates to take effect July 1.

The state authorities, having the facts, granted the increase, but the public, being less familiar with the conditions, objected. Led by a few radicals, a strike was begun which resulted in more than 800 telephones being ordered out.

The merchants and, in fact, a majority of the subscribers, were averse to the boycott, but were influenced to join the strike by the ring-leaders of the opposition to the company. The state commission is upholding the telephone company.

* * * *

"We are following, and expect to continue to follow, the order of the commission," says the manager in his letter. "In other words, a waiting policy has been adopted, and the subscribers are getting very tired of doing without telephone service. It seems now only a matter of time until the majority will throw overboard the few anti's who are leading the fight and resume business relations with us.

"It is a mystery how a few radicals in a community can influence a majority, as they have in many cases, when facts have been published setting forth the exact conditions, which prove beyond a doubt to the minds of those who will study the figures and information given them, that telephone companies all over the country must have relief if service is to be continued. And that is always the cry—increased service."

* * * *

This manager now has issued detailed statements to the people giving facts and figures for recent years, and also for the first quarter of this year, and pounding home the point that the new rates mean only about a penny a day to each subscriber.

This publicity is having a good effect, and the company no doubt will eventually win the fight, but the question occurs: "Would not all this trouble have been avoided if the right kind of publicity had been utilized earlier in the controversy—in fact, would there have been any controversy at all had friendly relations been established in past years?"

* * * *

President Perry, in the address mentioned, says he has absolute confidence in the fairness of the public towards all utilities when they know the truth. As the people get their information usually from the newspaper, he points out that the press has a peculiar opportunity for a real service to the public by seeing that the public gets the truth in such cases, especially

when a difference arises between a utility company and its patrons.

We all know from many cases observed, that the easy, popular way is for the newspaper to take the side of the public, and, without regard to the merits of the case, attack the company and pose as the champion of the people's rights. This is what the political demagogue always does. Mr. Perry is to be commended for his courage in condemning this policy.

* * * *

"It is not necessary for a newspaper that is really worth while to take the side of public opinion in such a controversy, regardless of the correctness of the position assumed," said he. "Far better that the truth be ascertained and give it to the public with no concern as to which side of the controversy it helps.

"If the public and the press would only approach such a subject with the facts in mind that there are 1,450,000 private citizens in this country with their savings invested in electric light and power companies alone; that the insurance companies have over $300,000,000 in the same securities and thus represent indirectly the savings of the poorer classes of people of the country; and the further fact that the 27 million depositors in the 29,000 banks in the United States have a direct interest in such utilities, because of the fact that their money amounting to $1,700,000,000, is invested in such securities—I believe they would be less inclined to embark on a course that at times means bankruptcy to the business, a hardship to the public and heavy losses to the investing public."

This is all true, and it serves to emphasize the importance of the utility company seeing to it that the local newspaper gets the facts and presents the truth to the community.

* * * *

The righteous complaint of the telephone manager that a few radicals are able to induce many otherwise level-headed men to join in attacking a service company touched upon a subject which, strangely enough, was also discussed by President Perry.

He argued that the public has a direct interest in the expansion of all utilities because a community cannot grow faster, nor extend further than its utilities can reach. Most sections need foreign capital to finance utility development, and, when local conditions are hostile to the operating company, outside investors will not be likely to risk their money there.

"The public," said President Perry, "has an interest in seeing that such conditions do not exist; it has an interest greater than the selfish interest of the few who would stop utility development of the community while their political ambitions are satisfied or a personal grouch is assuaged.

"It is a sad picture to see a community of inflamed citizens following the leadership of a few men in an effort to handicap or destroy a local utility, all because of a personal grudge on the part of self-styled leaders. This kind of thing has got to stop in this country or the public will pay the high price of stagnation in such growth with a breaking down of the present service rendered."

As long as there are political demagogues and newspapers playing for the support of the "peepul," no doubt the utility companies will have to count on their enmity, but the indications are growing stronger that the public now are not so easily befooled by these agencies as in other years.

Britain's Long Distance System

Development of the Toll System of the United Kingdom in Last 15 Years—Line Plant Design, Particularly in Underground Cables—Economies Effected—Paper Presented Before The Institution of Electrical Engineers

By Sir William Noble,
Engineer-in-Chief, British Post Office

At the present time long distance telephony in the United Kingdom divides along two main lines of development, namely:

(*a*) Communication between the principal commercial centers of the country.

(*b*) Communication with remote districts, and international communication.

In the former, the demand is for the provision of large numbers of circuits over distances up to 450 miles, e.g. London and Manchester, London and Glasgow; whereas in the latter the requirement is for a very few circuits, in most cases one or two only, over much longer distances, e.g. London to Belfast, London to Brussels, Paris and Marseilles, and in due course to Rome, Madrid, Constantinople or even Cairo.

Each line of development presents distinct problems of engineering design.

In the first decade of the present century it appeared that the ultimate possible efficiency in long distance telephone transmission had been reached; and that it was attainable only by the employment of the heaviest practicable copper conductors, erected on aerial lines, highly insulated, and revolved in pairs or quadruples to reduce inductive disturbances to a minimum.

In this country the maximum economical conductor was proved to be one weighing 600 pounds to the mile. A few circuits with 800-lb. conductors had been erected in the last decade of the 19th century, but their very small advantage in transmission efficiency as compared with 600-lb. conductors within the distances to be covered in this country, did not compensate for their much greater capital and annual costs.

On the basis of a total attenuation of $Bl = 2.5$ (representing a ratio of about 7½ per cent as between the received and transmitted currents—that is a loss of 92½ per cent) as being the limit for a commercial long distance line, the maximum length of a 600-lb. circuit was about 900 miles.

In this country, however, it was never possible to obtain the maximum efficiency of an aerial circuit on account of the necessity for short lengths of underground cables in passing through intervening town areas or across physical obstructions such as river estuaries, etc., and 60 per cent efficiency was the average obtained in practice.

Even under these conditions, good commercial service was given between centers so far apart as London and Glasgow, London and Dublin, London and Paris, and London and Brussels; and the lines available for these services had a fair margin of efficiency for extension to minor telephone centers in their respective areas.

From the time of the taking over by the Post Office of the trunk telephone service in 1896 until about 1910, it was possible to accommodate on pole lines

along the public roads and railways all the wires required to meet the public demand for trunk service. The accompanying table shows the increase in the number of trunk circuits radiating from London to the more important provincial centers.

It will be realized that the pole lines carrying these circuits radiating from London must carry, in addition, the shorter circuits connecting towns lying on the routes. For example, one of the London-Manchester lines passes through Northampton, Leicester, Derby and Buxton, and carries circuits serving those towns. Moreover, the requirements of the telegraph service have also to be met.

The congestion on the main aerial lines was becoming serious in 1910, and it was practically impossible to find road routes for new pole lines, especially in the approaches to London. The traffic development studies undertaken about that time forecasted a demand for trunk lines which could not possibly be met by any ordinary system of road pole-line construction, and a scheme of direct cross-country routes of steel tower construction capable of carrying very large numbers of conductors was prepared.

At this juncture, however, the results of a long series of experiments on the loading of telephone circuits with inductance coils, in accordance with the principles described by Pupin in 1900, indicated another line of development of the trunk telephone system. The earlier experiments with loading in this country were made with inductances of the air-core type, but these were replaced later by the improved iron-core types introduced by the Western Electric Co. of New York.[1]

Under the favorable climatic conditions of North America, the American Telephone & Telegraph Co. had obtained an improvement factor of 2.5 on the transmission efficiency of aerial lines, but in this country the climatic conditions were much less favorable, and even if the American standard had been attainable, and the weight of copper in aerial circuits correspondingly reduced, the prob-

						Est'mtd	
	1902	1905	1908	1914 -15	1920	1925	1930
Birmg'ham	4	7	14	32	37	60	76
Liverpool	8	10	14	35	37	63	80
Manchester	6	6	10	17	21	47	61
Leeds	2	2	9	13	14	20	24
Newcastle	1	2	8	10	9	14	17
Glasgow	4	4	4	6	6	10	12
Bristol	3	5	6	15	17	27	30
Cardiff	2	4	10	14	18	26	29
South'pton	1	4	6	11	11	20	25

Trunk Circuits Radiating from London to Provincial Towns.

lem of relieving congestion of the pole lines would have still remained.[2]

The results obtained by the loading of underground telephone cables with inductance coils were, however, more encouraging, and the attention of the engineering research department of the Post Office was, therefore, specially directed to this line of development. The manufacturer of dry-core paper-insulated lead-covered telephone cables had already reached a high stage of perfection, and the cables produced by the manufacturers of Great Britain were, and are still, the best obtainable in the world.

The history of the development of the long distance telephone cable is a record of undaunted perseverance in the solution of scientific and practical engineering problems which cropped up persistently as progress was made, and which frequently appeared to be insuperable. It will be instructive to review the various stages of progress in this development, and to recall the difficulties and the methods of overcoming them.[3]

The earliest underground cables used in the long distance telephone system were of the same type as those used up to that time in the telegraph service for subterranean lines. They were made up with copper conductors weighing 40 pounds to the mile, covered with 50 pounds of gutta percha to an overall diameter of 174 mils.

For telephone purposes these covered wires were laid up in quad formation around a jute core with an outer wrapping of tarred tape, the circuits being formed on the diagonals. These cables gave circuits with the following constants (per mile of loop):

$R = 44$ ohms.
$C = 0.2$ microfarad.
$L = 1.5$ millihenrys.
Insulation $= 1{,}000$ megohms.
Attenuation constant $= 0.12$ at 800 cycles per second.

The inefficiency of transmission of these cables restricted their use in the telephone trunk lines to the terminal sections in large cities, and to the leading-in at testing points.

Rubber-insulated conductors were also used to a very limited extent, but were found to give less satisfactory results in practice than the gutta percha cables.

The introduction of air-space cables with paper insulation and lead sheathing in the early '90's appeared to offer a solution of the difficulty in carrying telephone circuits underground, although the first practical experiments with this type of cable were somewhat discouraging. Numerous breakdowns of underground air-space paper cable sections occurred, and until the causes had been discovered and proper remedies found, maintenance engineers were reluctant to replace their old gutta percha cables with the air-space type.

Apart from questions of workmanship in drawing-in and jointing underground cables, the comparison between the two types was narrowed down to their respective susceptibilities to damage by light-

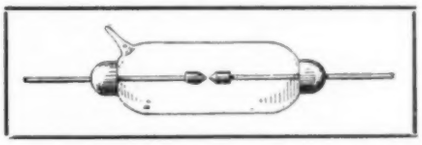


Fig. 1. Vacuum-Tube Lightning Protector.

ning, and in this respect the gutta percha cables appeared to hold a distinct advantage.

Short sections of underground cables connected with long lengths of highly-insulated aerial wires form effective spark-gaps for lightning discharges, unless very efficient protectors are installed at the ends of the cable sections. At the time of the introduction of air-space cables into the telephone trunk system, the standard type of lightning protector for underground sections was a small vacuum tube with platinum electrodes (Fig. 1).

These tubes were mounted in teak weatherproof cases fixed on the terminal poles at the junctions of cable and aerial line sections. The tubes were exhausted to a vacuum of about 2 mm. of mercury.

In spite of regulations for the frequent testing of these tubes, especially after thunderstorms, faults in underground cable sections caused by lightning were numerous: but whereas in the case of gutta percha cables the fault would be limited to perhaps one or two circuits only, in the case of air-space cables the lead sheath was melted and sooner or later moisture entered and the whole of the circuits in the cable were stopped.

The replacement of the faulty gutta percha cable was a comparatively easy and speedy matter, whereas the repair of the air-space cable was frequently a difficult and tedious operation entailing a considerable loss of revenue-earning time on the circuits involved. Considerable experience had already been obtained in the use of air-space underground cables for short telephone circuits in city areas, and their superiority over gutta percha cables for this class of service had been proved.

Damage by lightning was unknown in the case of wholly underground circuits. The design of a more efficient lightning protector for trunk cable sections and improved workmanship in handling and jointing lead-sheathed cables soon established the air-space cable for trunk-line purposes, and at the end of the last century gutta percha subterranean telephone cables were obsolescent, all renewals being effected with air-space cables.

The superior transmission efficiency of the air-space cable, and the fact that much heavier conductors could be used as compared with gutta percha cables, permitted longer underground sections in the trunk routes, and so afforded a solution (al-

---

[1] J. G. Hill: "Telephone Transmission"; A. W. Martin: "The Loading of Telephone Cable Circuits." Institution of Post Office Electrical Engineers, Professional Papers.
[2] J. G. Hill: "The Loading of Aerial Lines and their Electrical Constants," Ibid., No. 54.
[3] J. A. Fleming and G. B. Dyke: "The Power Factor and Conductivity of Dielectrics," Journal I.E.E., 1912, vol. 49, p. 323.

though only a partial one) of the increasing difficulty in carrying heavy main routes through urban areas and into the main terminal towns: but with the extended lengths of underground sections, a fresh difficulty, which had not been apparent in gutta percha cables, cropped up, namely, increased cross-talk between adjacent circuits.

Early Cables and Long Distance Circuits.

In the gutta percha cables the mean distance between loop circuits and the comparatively short lengths of underground sections were such as not to increase perceptibly the mutual disturbance between neighboring circuits; but the close packing of the conductors of the air-space cables and the increasing length of cable sections introduced conditions of mutual disturbance which had serious effect on the commercial efficiency of the long distance circuits.

At the outset, this limit to the use of air-space cables for long distance telephone circuits appeared almost insuperable, but in view of the importance of a solution of this problem, special attention was given to it by Post Office engineers. F. Tremain and A. W. Martin, between July and October, 1899, made an exhaustive investigation of the electrical properties of a 93-mile section between London and Leamington of the first London-Birmingham air-space underground cable.

This investigation had for its principal object a comparison of the telephonic cross-talk between telephone circuits and inductive disturbances between telegraph circuits in the two types of construction used in this section of cable. This section was made up, broadly speaking, of 28½ miles of quadruple-core formation from Cricklewood to Eddlesboro, the remainder of the section being made up of wires twisted in pairs.

Although every effort was made by the cable manufacturers to produce symmetrical cable with the view of minimizing cross-talk, it was found that speech telephonically transmitted over a loop made up of diagonal wires in a given core of the quadruple formation could be heard in a telephone joined to the other pair of wires in the same core; but between diagonal pairs of neighboring cores, no such cross-talk was observed in the 28½-mile section tested. This result was attributed to the distortion of the quadruple core, and it was then concluded that the defect in this type of air-space cable was too difficult, if not impossible, to remedy in the course of manufacture.

Attention was then directed to the cross-talk observed between neighboring loops in the pair-type formation, and it was found that the cross-talk was practically negligible between two circuits of 52 miles in length when these circuits did not run for more than 5¼ miles in adjacent pairs. This ratio, i.e. 10 per cent of length of adjacent wires to length of the whole circuits, was considered significant and was used as a guide later in the investigation, for arranging crosses to eliminate or reduce cross-talk disturbances.

The investigators found in their experiments with the 28 miles of quad-core cable that they could eliminate cross-talk between the two circuits carried by a quad core, by making crosses of individual wires, and pairs of wires, at six intermediate points in the 28-mile section. They employed seven distinct varieties of crosses, namely, crosses A, B, and C in which the individual wires in either or both pairs are crossed; cross D, in which one pair of wires is crossed with the other pair; and crosses E, F, and G in which the pairs themselves are crossed in addition to the individual wires of one or both pairs.

This systematic method of crossing exhausted the possible number of crosses which could be made in joining up the four wires of a quad core. Messrs. Tremain and Martin have pointed out that 42 possible single crosses could be made at the six intermediate crossing points without making a cross from one core to another. By making a total of 650 crosses, of individual wires and parts at the intermediate crossing points, they succeeded in making this 28-mile section free from telephonic overhearing or cross-talk without necessitating any crossing of cores, a consideration which, at that time, was of some practical value.

The investigation of cross-talk in the pair-type formation indicated that no appreciable cross-talk would occur when crosses of pairs were made at intermediate crossing points, to ensure that no two pairs of wires remained parallel and adjacent for more than 10 per cent of the total length of the circuit. At a subsequent date a systematic method of balancing by crossing cores wrapped with paper of different colors was adopted in order to satisfy this condition.

Method of Balancing Cable Conductors.

The balance obtained by this method of crossing proved so effective that the telephone loops in the central portion of the cable were not seriously interfered with by single-wire telegraphs in the outside layer, nor vice versa. It was also observed that a key-speed telegraph circuit worked on a loop did not interfere with the telephone circuit in an adjacent loop.

Even Wheatstone, working on a loop, did not interfere with the telephone circuit, provided one pair of wires was interposed between the two circuits. It was further reported in this experiment, that so long as the rule was observed that no two pairs of wires were parallel and adjacent for more than 10 per cent of the whole length of the cable, loops could be used indiscriminately for telephone or telegraph circuits.

It may be mentioned that before these results were obtained the investigators found it necessary to measure the electrostatic capacity of every wire in every section of the cable and, similarly, measurements of copper resistance were made to the highest accuracy obtainable with the apparatus then available, the figures being recorded to 1 in approximately 10,000 parts for capacity, and 1 in 5,000 parts for resistance.

The jointing procedure adopted as the result of the foregoing experiments fulfilled all requirements of the Post Office, until the method of improving the efficiency of telephone circuits by inserting inductance coils was adopted. The placing of loaded telephone circuits in the underground cables necessitated a reconsideration of the practice of providing telegraph and telephone circuits in the same cables, owing to the fact that loaded circuits, while being more efficient than unloaded ones, are at the same time more susceptible to inductive disturbance.

Disturbances to Loaded Cable Circuits.

Experiments showed that Wheatstone circuits on single wires caused serious disturbance to loaded telephone circuits in the same cable, and in some cases marked induction had been experienced on such circuits from Wheatstone circuits worked on loops. In consequence of these difficulties, it became necessary for a time to provide separate cables for telegraph and telephone purposes.

As the trunk underground system grew it was found uneconomical to provide separate cables for the two services, and special efforts had to be made to overcome the difficulties experienced. The method of superposing loaded telephone circuits on other telephone circuits already loaded was also found impracticable with the same degree of balance in the conductors which was found sufficient for unloaded circuits.

In 1912 it was found with the usual method of cable construction that the practice of placing telegraph circuits in the same cable as loaded telephone circuits would have to be abandoned, and that phantom loaded telephone circuits could not be successfully superposed upon loaded physical telephone circuits without improving the symmetry of the conductors in underground cables or improving the balance of the conductors by selective jointing.

As a consequence of the difficulties experienced, the whole question of cable design and balancing by selection of conductors for jointing was taken in hand afresh by the research staff of the Post

(*Continued on page* 33.)

Principles of Telephone Traffic

One of a Series of Articles Setting Forth the Fundamental Elementary Principles of Telephone Traffic Work—Every Operator and Manager Should Read These Articles — This Article Discusses Details of Service Observation

By E. L. Gaines

Traffic Superintendent, Home Telephone & Telegraph Co., Ft. Wayne, Ind.

A movie film illustrating the manufacture of fountain pens was recently exhibited in many of the leading cities of the country.

The picture showed how the rubber was taken from rubber trees on the company's plantations in South America, made into rubber biscuits and transported to the coast, where it was carefully inspected and loaded onto a boat to be shipped to the United States. Upon arrival at the company's factory, the rubber was again carefully inspected, washed and thoroughly cleaned, ground and prepared for the molding and vulcanizing process.

Each piece of rubber, as taken from the molds, was carefully inspected for flaws, both before and after vulcanizing. After the parts were machined, each one was carefully gauged as to size and the number of parts continuously checked. The greatest care was always taken to throw out any defective pieces.

The gold, as received from the mines, was tested by the company's chemists and treated with acids to remove all impurities. It was then mixed with other metals to form just the right grade of alloy for making pen points. Each and every part and piece of the pen was carefully graded and inspected, always under the microscope, at every stage in its journey through the factory.

After the pen was completed, it was subjected to an air pressure test under water to determine whether or not it would leak, and the final pen, after being polished and finished, was subjected to a most rigid kind of a writing test by expert penmen.

The purpose of the picture was to impress upon the minds of the public the impossibility of a defective pen getting to the ultimate owner and user. This illustration of the manufacture of fountain pens show, at least, in a measure the method generally used by all manufacturers to assure themselves of the quality of the product of their plants, and also to enable them to keep a perfect check on all materials entering their plants and on products turned out.

In the telephone business we do not manufacture tangible articles of commerce, but nevertheless we are producers of an intangible commodity for our patrons in the form of telephone service, which needs to be carefully checked and graded at all times in order that we may know the quality of that service as well as the quantity that our subscribers are receiving.

It is, therefore, necessary to make actual observations of the telephone service, carefully checking the different features that go together to make up service, in order that we may detect any defective operation or equipment trouble and guarantee to our patrons the worth of their money in good service.

In the factory it is necessary that not only the materials be carefully inspected at all stages throughout the manufacture, but it is also necessary to keep a check on the laborer and the quality of his workmanship, and also to inspect the machinery and equipment to be sure that it is in good working order and functioning properly.

The machinist in the factory does not allow his machine to fall apart and stop running before making adjustments and repairs, but by an almost continuous inspection detects the loose screws and nuts and tightens them up and prevents trouble. So it is necessary in the telephone business to make routine inspections of central office equipment and equipment at the subscribers' premises, in order that we may make such adjustments as may be necessary before actual trouble is encountered and the service impaired.

This equipment inspection is, in reality, a part of service observation, and it is necessary to know the average number of times a subscriber's service is interrupted by line or equipment trouble to intelligently determine the kind of service he is receiving.

A complete service observation would show not only the number of cases of equipment trouble but would also show the average length of time the patron must wait to have a telephone installed, how long he must wait to have moves and changes of equipment made, how many errors occur in statements rendered him by the company each year and, in fact, a detailed record of all of the operations of the company at every point where it comes in contact with the subscriber. But owing to the fact that what is ordinarily termed telephone service takes into consideration only the actual interconnection of subscribers' lines by the operator, service observation records show only the more important features of actual telephone connections.

DETAIL SERVICE OBSERVATION RECORD

Date_____ 192__

Observation number	1	2	3	2.5
Time				
Number calling				
Number called				
Plug interval				
Operator answers				
Acknowledgement				
Local answer				
Trunk answer				
Calling disconnect				
Called disconnect				
Length of conversation				
Operator disconnects				
Disconnect interval				
Call not completed				
Errors				
Improper repetition				
Improper phraseology				
Impertinent or discourteous				
Careless supervision				
Miscellaneous				
Flashes and recalls				
Subscribers' irregularities				
Remarks				

1-Calls abandoned
2-Busy, flash back
3-Busy, report
4-Don't answer
5-Cut-off
6-Double connection
7-Wrong No. connected
8-Incorrect report
9-Indistinct (Repetition or phrase)
10-Cuts out too quickly (Rep. or Ph.)
11-Explanation in "Remarks" column
12-Attempt not answered-cleared up
13-Disco. while Sub. is flashing
14-Sub. flashes improperly
15-Attempt not answer'd--Sub. hung up
16-Cut-off by P. B. X. attendant
17-Fails to correct wrong No.
18-Sub. calls wrong No.
19-Sub. interferes on party line

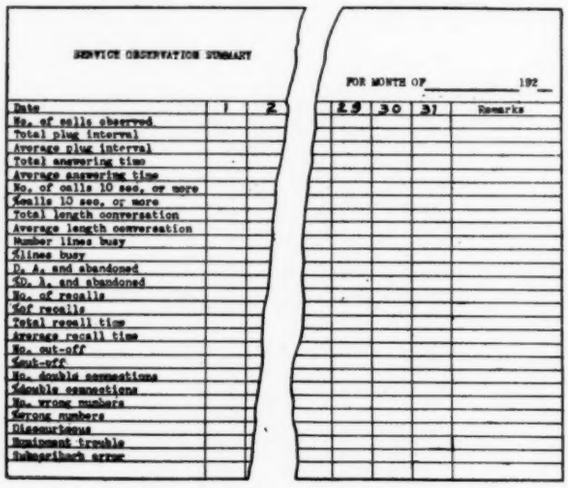
Fig. 19. Blank Form for Service Observer's Use.

For this purpose it is customary to install a service observation board by means of which any subscriber's line entering any office of the exchange may be connected at will. Means are provided whereby the observer may instantly detect the exact time when a subscriber takes down his receiver, can tell when the operator plugs in the line to answer, can hear her and thus detect the proper or improper use of standard phrases prescribed for the operator, can hear the subscriber give his request for a connection and also hear the operator's repetition of the number requested and, in fact, can observe in detail practically everything relating to the call that affects the service in any way.

Provision is usually made for making observations on from 20 to 30 subscribers' lines at one time. The observer can watch all of these lines but, of course, can only observe upon one line at a time.

A special blank form, Fig. 19, is provided for the observer upon which are noted the various details of the call, such as the number of the calling party, the number called; the time at which the call

was made; the plug interval, if any, or the length of time it takes the operator to answer after she plugs in on the line; the total answering time, or the time it takes the operator to answer after the subscriber removes his receiver from the hook; incorrect requests for numbers by subscribers, or subscribers' errors; incorrect phrasing or repetition by the operator; the length of time it takes the called party to answer on both local and trunk connections; errors of the operator such as ringing the wrong party; errors of the subscriber, such as, giving the wrong number; the length of conversation on both local and trunk calls; the disconnect time, or the time it takes the operator to get the connection down after the parties are through talking; the recall time, or the time required to get the operator to answer when another connection is desired.


SERVICE OBSERVATION SUMMARY

FOR MONTH OF _____ 192__

Date	1	2	29	30	31	Remarks
No. of calls observed						
Total plug interval						
Average plug interval						
Total answering time						
Average answering time						
No. of calls 10 sec. or more						
%calls 10 sec. or more						
Total length conversation						
Average length conversation						
Number lines busy						
%lines busy						
No. A. and abandoned						
%No. A. and abandoned						
No. of recalls						
%of recalls						
Total recall time						
Average recall time						
No. cut-off						
%cut-off						
No. double connections						
%double connections						
No. wrong numbers						
%wrong numbers						
Discourteous						
Imminent trouble						
Subscriber's error						

Fig. 20. Monthly Service Observation Report Form.

A record is also kept of calls not completed owing to lines being out of order, or busy, or by the called subscriber failing to answer and the calling party abandoning the call. Errors of the operator and subscriber are tabulated separately and a record is also kept of all miscellaneous irregularities connected with the service.

In some local service observation boards equipment is also provided whereby the observer may listen in on the telephone circuit of any operator in the office. The observer is then able to secretly check the work of each operator, observing all irregularities of service, the accuracy of connections, impertinent or discourteous treatment of subscribers and careless supervision of calls.

It is thus possible not only to grade the service as a whole but also to grade the work of each individual operator and to pick out the flaws of the individual employes and make such corrections as may be necessary.

Most traffic men agree that, in order to obtain a dependable service observation, it is necessary to have a record of 1 per cent of the total number of calls handled in one day. Thus with a load of 100,000 calls per day, the observation of 1,000 calls would give an accurate and dependable record of just what the telephone service actually was.

It is necessary that the calls observed be taken at all hours of the day, since the service during one part of the day with a certain group of operators might be good, though very poor during other hours with less experienced help. Observations, therefore, are taken on hours which vary on different days of the week, and different weeks of the month, from 6 a. m. to 10 p. m., so that an average service at all times of the day may be secured. It is desirable also to secure the greatest number of calls at the time the load is the heaviest in order that the average may be fair.

The results of all observations taken in one day are tabulated and averaged to determine the quality of service rendered during the day. These daily averages are tabulated on a monthly report form, Fig. 20, in such a manner that the average daily service is shown for each day of the month, and the total average service for the month may then be obtained.

In this manner it is possible to go back over records and pick out any certain day, week, or month and tell just what the service was at that time. By comparing the service with adopted service standards, one may determine whether the service is above or below what may be termed "standard service," and also by comparing present service with former service, tell whether it is improving or slipping back.

It is an interesting fact that if a curve is platted of the number of service complaints received, it will be found to bear inverse relationship to a curve platted showing the efficiency of the service, thus proving, beyond any doubt, that subscribers do complain if the service is not satisfactory.

The observation of long distance lines and service is accomplished by providing the service observer with a duplicate of the long distance multiple. Associated with each line in the multiple is a calling signal. The observer is thus enabled to check all incoming calls and to monitor on any toll circuit entering the exchange. A duplicate of all recording and service trunks is also provided on the service observation desk, by means of which the observer can check every detail of recording, trunk holding and handling the subscribers' lines.

The checking of the individual local operator's work should not ordinarily be a part of the regular service observer's duties.

It is difficult to provide sufficient equipment on the service observation board to allow the observer to follow all calls in every detail and determine at the same time which operator handles each detail of the call. An observer who checks the work of the individual operator is called the "operator observer" to distinguish her from the "service observer."

In order that the operator observer may have access to the subscriber's multiple and also to the multiple of outgoing trunks, she is located at a vacant position on the local switchboard and provided with two receivers on a single head band, one of which is connected directly to the monitor taps on the position to be observed.

Attached to the other receiver is a cord and plug by means of which she is enabled to follow a call, by plugging in the jack of the line called for in the subscribers' multiple, after she has heard the number requested of the operator whose work she is observing.

In this way she can check wrong numbers, busy lines, etc., and by going in on the trunk jack of the trunk assigned she can follow a trunk connection through as well as a local connection.

In this manner it is an easy matter to check the work of an individual operator and also to establish a system of grading the operators' work.

Want American Bell and Indiana Bell Relationship Investigated.

The Indiana Public Service Commission has been asked to ascertain in detail the exact relationship between the American Telephone & Telegraph Co. and the Indiana Bell Telephone Co. which has petitioned the commission for an increase in telephone rates at Muncie, Anderson and Indianapolis. The information was requested in a petition filed by the city of Muncie, through City Attorney McPhee and Fred Bates Johnson, of Indianapolis, special counsel.

"The relationship between the American Telephone & Telegraph Co. and the Indiana Bell company is of great importance and the city of Muncie desires to ascertain what the exact status of the two companies are," says the motion. "Published statements of the American Telephone & Telegraph Co. indicate that it is making a large return and paying high dividends. Common sense would seem to indicate that the parent company is skimming the cream and local exchanges are paying the freight."

City officials in the three cities in which the Bell company is asking for increased rates are preparing to launch a vigorous attack on the company's petition.

Existing "York State" Rates Approved

New York Commission in the Syracuse Rate Case Decides in Favor of a State-Wide Basis for Fixing of Rates — Present Syracuse Rates, Increased in December, 1919, and September, 1920, Stand as the Result of the Order

The New York Public Service Commission August 4 dismissed the complaints of Harry H. Farmer, mayor of the city of Syracuse, against the New York Telephone Co. relative to increases in rates in that city. The decision is the result of an increase in rates in Syracuse in December, 1919, and a schedule filed by the company for rates to be effective September 1, 1920. No objections were filed in opposition and the new schedule went into effect. Later the city rose in protest.

Similar increases were made in rates in more than 137 municipalities in the state, and a conference of mayors decided to select one of the municipalities through which to prosecute a test case against the advance. Syracuse was selected because it represented an average situation and because the city itself had already instituted the necessary proceedings.

In its order the commission ruled that the rates charged by the company from its regulation and the property used and useful in public service should be considered on a basis of its state-wide activities; that the forced and artificial segregations attempted do not afford a satisfactory basis for the proper determination of either valuations or rates; and that the availability of service and its development to the highest possible degree irrespective of municipal boundaries are essential to that character of telephone service which the public demands.

During the progress of the cases, which were consolidated, many other municipalities of the state made formal complaints against the rates of the company, both as to local tariffs and toll charges. The commission suspended the rate schedules placed in effect in many of the municipalities in September, 1920. The company then filed a bond and the rates went into effect and have been collected ever since.

History of New York Company.

The New York Telephone Co. was by charter authorized to carry on a general telephone business in the state of New York. Prior to 1909 it had been operating in the city of New York and in Westchester county. The company under its charter rights purchased, consolidated and merged all or nearly all of the companies operating in the state and gradually eliminated competition.

In doing this it acquired a controlling stock interest, bought the companies outright, or bought large stock or bond interests through agreements by which the smaller companies became affiliated with the larger organization. In some companies it has no financial interest, but has connecting agreements.

For all practical purposes the company now operates some 475 central offices, 1,354,576 directly-operated stations, 71,224 controlled company stations, and 79 connecting company stations, necessitating the use of about 5,000,000 miles of wire, and 1,700 miles of subway. Of the total telephone stations in the state of New York, 95 per cent are owned or controlled by this company.

Since the merger and consolidation of the various companies by the New York company, great progress has been made in the upbuilding of the physical property, and telephone development as regards service has been undertaken on a large scale. In doing this the whole territory of the state has been developed to such an extent that prior to the period of governmental control, there was little or no complaint as to the service.

Method of Proof.

The company, in the presentation of the case, held that to give it a fair return upon its entire business, the value of all its property used and useful in the business in the state of New York should be considered and a rate of return predicated upon the property as a whole. It also maintained that the ultimate distribution of the rates was to be determined by an examination of the service conditions in each community from a telephonic standpoint, and that after such an examination the determination of whether the rates established were unequal or unjustly discriminatory should be made.

The representatives of Syracuse held that under the public service commission law, the value of the property used in supplying telephone service, covered only by the local exchange rates was to be considered; that the burden of the rate payer assumed was that of a responsible average return upon the value of the property of which he had the actual use; that the local exchange service charge was and should be based on the value of its local property.

The Syracuse representatives further held that the value of the company's properties and service in other communities of the state had no relation to the rate in the municipal area of Syracuse. To adapt their proof to a conformity with this method, the complainants had to assume the burden of segregating toll service from purely local exchange service. This involved the segregation of the local telephone property, the revenues and the expenses.

The admissibility of evidence and the mode of procedure depended on the decision of which theory—that is, the state-wide basis, or segregated district basis, should be followed. The former state commission had ordered briefs to be filed and adjourned the cases pending the decision and determination of the matter.

Thereafter, the commission ruled that the reasonableness of rates should be determined upon the basis of property in the local area, although evidence showing the value of the entire property, the amount of its revenues and its operating expenses might be admitted for the information of the commission and for such aid as might be rendered to the commission in ascertaining the facts applicable to the local area.

The commission, in the decision of this question, naturally had to take into consideration its legal right to consider the state-wide operations of the company, the policy of state-wide regulation as opposed to restricted district regulation, and the propriety of rates and their fixation.

Apparently relying on the theory that the same rule should apply to every community which applies in case of a utility serving the public only in a single community, it decided in favor of such procedure, assumed it was not within its power under the law to act otherwise, affirmed the policy of viewing each segregated locality as a unit, and fixing rates for telephone service in such localities, irrespective of rates in other similar communities.

The Franchise Agreement.

The city held that the company was conducting its operations in Syracuse under a franchise granted to its predecessor company, the Central New York Telephone & Telegraph Co., and that the company by accepting the franchise which contained the following:

> Sec. 14: This permission is granted upon the further condition that the Central New York Telephone & Telegraph Co. shall not increase their present rate for telephone service, and shall furnish to the city of Syracuse 15 telephones to be placed by the committee on the city hall and city property.

was bound by the rates in effect on August 2, 1897, and that the increased telephone rates made effective on December 1, 1919, were in excess of the maximum rates permitted by the franchise.

There was no doubt, however, as to the

authority granted the commission, under Section 97 of the public service commission law, as amended in 1921. (Also Murray vs. New York Telephone Co., 226 N. Y. 59; Peo. ex. rel. Vil. S. Glens Falls v. Public Service Commission. 225 N. Y. 210.)

Regarding the physical valuation there was difficulty due to the fact that the company apparently based its proof on value and the city upon cost. Of course, value and cost may not be the same, and the power of the commission to fix rates, as set forth in Section 97 of the public service commission law, was limited to "a reasonable average return upon the value of the property actually used in the public service." (P. S. C. Law 1921—as amended—Wilcox vs. Cons. Gas Co. 212 U. S. 19-23; Peo. ex rel. Iroquois Gas Co. 194 A. D. 578.)

There was little dispute in regard to the value of the land items in the Syracuse area. The company was entitled to an increase over cost resulting from the advance in value. In other words, it was held that the land should be taken at its present value. The company offered to corroborate its proof in regard to these items by the opinions of real estate experts, and offered to call these men as witnesses if the city desired, but no such request was made, and it was held that the company's estimates were correct.

The Syracuse representatives urged disallowance of all items set up by the company as "overhead" or "preliminary and development" expenses. The company claimed that these overhead construction costs included general, executive, financial and legal expenses, items of engineering and superintendence not covered by initial costs, taxes, insurance, and interest during construction.

"There are certain expenses connected with every undertaking which are not represented by physical property, but which must be incurred before the plant is operated. These relate to the initial promotion of the scheme and the organization of the company. Investors must be interested, lawyers and engineers must be consulted, and franchises and permits must be secured. Interest and taxes during the period of construction must be paid and as there are no earnings, they must be included as part of the cost of the undertaking. There are also other expenses . . . which antedate operation."

(See opinion of Maltbie, Commissioner, in Cases Nos. 1224-1225—Matter of Queensboro Gas & Electric Co., P. S. C. 1st Dist., Vol. 11, page 564.)

The company produced no data upon which to base an estimate of a reasonable allowance for past investments and claimed inability to show what these expenditures were since the early records were missing. Therefore only an estimate could be made.

While the percentage to be allowed presented much difficulty, owing to the lack of evidence of actual costs and the fact that an arbitrary and disputed segregation of costs was being dealt with, the percentages allowed in similar cases by other regulatory bodies were used as a basis of comparison.

In various cases the allowance had been 15 per cent. In the Queensboro Gas & Electric Co. case, previously referred to, the allowance amounted to 17 per cent; various allowances in Wisconsin were made on the basis of 12 per cent and an allowance of 20.5 per cent was recently made.

Although, the commission maintained, it could not be said that the 12½ per cent allowance claimed was justified by the evidence, in view of the size of the company, the value of its business, the way in which it has grown, and the amount of expenditures which must have been made, it was held that an allowance of at least 10 per cent was justifiable.

In regard to "going value," the strict application of the "going value" theory to the utility company protected from competition presented an interesting question. The city of Syracuse claimed no allowance should be made and that such values were already reflected in the capital account of the company.

The company claimed a "going concern" value in the present case of $1,600,000. The difficulty was to prove the actual amount entering into "going value." In this case, there was a lack of satisfactory evidence both on the part of the company and the complainant.

The commission held it impossible to attempt any estimate of "going value," both on account of the lack of evidence and on the ground that under the "segregated area," any such finding should be based on misleading and incorrect premises.

In the matter of expenses, the largest single item was that of "traffic." The complainants asked a 10 per cent reduction in this item, an $11,000 reduction in "commercial" expense, and $13,000 under "general and miscellaneous." The city furnished elaborate tables showing the downward trend of prices, and argued that under these conditions, and with the apparent surplusage in the labor market expenses would not be as much as represented.

As stated by the commission: "There is a general trend in current market prices of materials and there is also tendency toward lower labor costs, but the fact remains that if we disregard the 1921 estimates and only consider 1920 expense figures are considered we are working with items which have been actually paid.

"Labor costs made up nearly all of 'traffic' expenses and at least 80 per cent of 'current maintenance.' These labor costs have not yet reflected the intent of the downward trend shown in the commodity charts. Any decrease in these items should be arbitrary and should not be made until checked by the figures of experience.

"Various other items of 'miscellaneous expense' were attacked by the complainant and much was said about the expenses of publicity. This company attempts to keep the public advised of its policies. Such a practice is in line with that followed by other business enterprises and because a concern is a public utility it does not follow that it should not, in a reasonable way, make public its program and policies."

The toll business of the company has aways been and is now carried on through local exchanges and is an integral part thereof. Added plant in the larger central offices is necessary and this is the only part of the company's property which can be called, with any degree of accuracy, its "toll plant," for the service is practically identical, except in the matter of "length of haul," and even this is not always a measure of difference. Local exchange boundaries are not purely local or municipal, but are artificially created by the company to prescribe and make equal the "short-haul" rate for the subscriber using the local service.

Segregation such as was proposed in this case was a new departure. Under this method the expenses allocated to toll business exceeded the toll revenues. If these toll rates were increasd, might not the effect be the killing of the toll business? The only equipment eliminated in that event would be some part of the wires, the toll-board and a small part of the line plant.

Or following the theory through, it might result in establishing toll service telephones, toll exchanges and an entirely separate equipment. Then, with the toll service set up by itself, the exchange service would not be as valuable. Their intimate relationship makes each much less valuable if separated.

In either event, it was held that it would be in the matter of service exactly where it began, and 20 years of development in ease and convenience of telephone service summarily cast aside. The commission maintained the potential service

MAKE OPPORTUNITIES.

If you want to succeed in the world you must make your own opportunities as you go on. The man who waits for some seventh wave to toss him on dry land will find that the seventh wave is a long time coming. You can commit no greater folly than to sit by the roadside until some one comes along and invites you to ride with him to wealth and influence.—John B. Gough.

resulting from every telephone instrument being a toll instrument was much too valuable as a public convenience to be thus disposed of.

The stock of the New York Telephone Co. is owned in its entirety, with the exception of the qualifying shares, by the American Telephone & Telegraph Co. There is between these two corporations a contract by which the American Telephone & Telegraph Co. supplies the New York company with certain apparatus, and furnishes certain advisory service, legal, engineering, accounting, and otherwise, and aid in financing the New York Telephone Co.

The Syracuse representatives claimed that there was no evidence of any kind of any value accruing to the New York company from the contract; that because of the intercorporate relationship the contract should be carefully scrutinized; that no proof of value being offered, fact of existence was not proof of performance; that burden was upon the company to justify the contract in that some proof of compliance with its terms and amount and value of service rendered be furnished.

The commission stated that while there was no hesitancy in pronouncing the contract to be suspicious on its face and while it was convinced that the basis for payments of 4½ per cent on gross revenues was unbusinesslike and fundamentally improper, there could be no relationship between any per cent of gross revenues and the cost or value of the service rendered by the American Telephone & Telegraph Co., yet the payments made, in some part at least, were for definite things and based on this estimated allocation no sound deduction could be made to offset the payment estimated as proper in the Syracuse district.

The commission stated that it believed, however, in common with the rate-making bodies of several of the states, that the contract with the American Telephone & Telegraph Co. should be definitely and finally inquired into and its entire effect considered, to the end that a sound basis might be fixed for payments which should not be fraudulent in their effect on the rate payer.

The company's net telephone revenues of $1,452,350 indicated a return of approximately 7.8 per cent on the assumed 1921 rate base. While the commission used the valuations and percentages to illustrate some of city's contentions and while it did not agree that they were correct, it held that under the assumed figures favorable to the claims of the city, the results indicated an approximate return of less than 4 per cent for 1920 and less than 8 per cent for 1921.

The commission held that the value of the company's property used and useful in the public service, its rates charged, and its regulation, so far as the regulation could go in the matter of policies and practice, should be considered on the basis of its state-wide activities; that the forced and artificial segregations attempted in the case did not afford a satisfactory basis for the proper determination of either valuations or rates; and that the availability of service and its development to the highest possible degree, irrespective of municipal boundaries, were essential to that character of telephone service which the public demands.

In order to alter rates or to fix new ones in these cases, the commission held that it "must first find that the rates put into effect by this company are unjust, unreasonable, unjustly discriminatory, unduly preferential or in violation of law. And such a finding must be based on evidence. We fail to find such evidence in these cases."

"EXCUSE IT PLEASE."

By Miss Anne Barnes

Travelling Chief Operator, Iowa Independent Telephone Association, Des Moines, Iowa

There's a girl in the world who is making mistakes,
To correct them she never will try,
And the strongest of all restitution she makes
Is to give an excuse and get by.

When she uses her thumb to push plug into board,
And it catches the chief's watchful eye,
"Oh, my finger is sore," she says pulling the cord,
That's her quickest excuse to get by.

If she's late and she says she was held by a train,
She thinks she is being quite sly,
For she knows that she stopped on the corner with Jane,
But she gave an excuse and got by.

She is never in fault and she never takes blame,
An excuse is a small white-washed lie,
So in truth or in fiction to her it's the same,
She'll give an excuse and get by.

But for how long? Every time I hear a new excuse I think that I have heard the last thing in excuses, so every now and then I get a surprise.

There was a girl in Crystal City who was as full of excuses as a temperance preacher is full of horrible examples. They were good. Long detailed descriptions of sad incidents and compelling circumstances which made it inevitable that she should be late.

One morning she had us nearly in tears when she told of the little boy whose father had beaten him. Of course, Fannie stopped to remonstrate with the father. The next day she helped a poor blind man across the railroad tracks. If it rains, she has to stop to shut the windows, lend an umbrella to an old lady, or perform some other philanthropic duty. Can we discharge a humanitarian such as she? The whole force knows her. When Fannie is late, everyone in the room listens expectantly for her excuse.

The other day in the restroom I overheard Fannie and another girl talking.

"Why don't you come on time, Fannie?" asked the girl. "I should think that it would be harder to think up excuses than to get here early."

"Say, kid, what's the use?" said Fannie, airily. "They swallow that sob stuff hook, line and sinker. What's the use?"

Fannie is right. What's the use? We couldn't see much use for Fannie after about six months. I was sorry to see her go. It isn't often one finds originality such as hers. But the trouble is that her originality is a drawback to service, and is likely to affect the morale of the force.

Telephone Rate Advance Halted in Rochester, N. Y.

Proposed rates of the Rochester Telephone Corp. to be effective August 1, were ordered suspended by the New York Public Service Commission July 29. The company was also ordered to file a temporary schedule reducing a certain class of rates from those proposed. The suspension will be effective pending the hearing and determination of the complaint of Mayor Edgerton of Rochester.

The temporary schedule was ordered to provide a rate of $4 for 80 local messages or less a month on an individual line, business and residence with a further reduction for all messages over that amount.

The order held that the public interest requireda change in the schedule of rates as proposed by the company.

"Telephony's" Home Study Course for Telephone Men

A Complete Presentation of the Principles Underlying Modern Telephony in All Its Branches—Arranged Systematically So That Regular Reading and Faithful Study Will Qualify Ambitious Men for Higher Positions—Prepared Under Supervision of Stanley R. Edwards—This Section Written by Jay G. Mitchell

CHAPTER XXXIII. Operating Combinations Including Switches. (Continued.)

1125. *The first selector.*—The relay-type line-finder shown schematically in Fig. 319 may be adapted to any one of the standard types of circuit arrangement for connecting the trunk circuit to the *called* line. Such a scheme has appealed to several inventors and offers some advantages when the line-finder is combined, for instance, with the conventional cord plug and multiple. The entire arrangement might then be designated a "traffic distributor."

It is obvious that the operation of the equipment shown in Fig. 319 is exactly equivalent to the result obtained by the conventional type of line switch described in connection with mechanical switching. The calling line is first connected to an available trunk circuit and the subsequent stages of the call may be completed by any operative type of switching equipment. In the further discussion of this arrangement, however, only the method which has been placed in commercial operation in connection with the circuit shown in Fig. 319 will be considered. In this scheme, operators are employed to take the calling subscriber's order while many operating functions are mechanically performed.

When multiple-contact relays *L* and *N* have been operated, a flow of current through the transmitter and primary circuit of the *calling* telephone will take place over the talking current supply circuit which is traceable as follows:

Starting at the positive or grounded terminal of the common battery, current will flow through the winding of the impedance coil *A*, Fig. 320, the associated conductor of trunk circuit, the jumper trunk conductor *X*, Fig. 319, the normally-open make contact of multiple-contact relay *N* (now closed), the jumper trunk conductor *U*, a normally-open make contact of multiple-contact relay *L* (now closed), one conductor of the calling line, the telephone, the other conductor of the calling line, a normally-open make contact of multiple-contact relay *L* (now closed), the jumper trunk conductor *V*, a normally-open make contact of multiple-contact relay *N*, (now closed), the jumper trunk conductor *Y*, the winding of current-supply relay *B*, (Fig. 320), and the common battery.

As a result of the passage of current through this circuit, current-supply relay *B* (Fig. 320), is energized. Current for the operation of the *calling* transmitter, throughout the entire duration of the call, is supplied through the windings of impedance coil *A* and current-supply relay *B*.

As an immediate result of the operation of current-supply relay *B*, slow-acting relay *D* (Fig. 320) is energized. It is to be noted that the two drawings, Figs. 319 and 320, are so related that wires leading from that portion of the circuit shown in Fig. 319 may be traced into that portion shown on Fig. 320 by placing the drawings so that the two heavy lines representing the two conductors of the talking circuit trunk join.

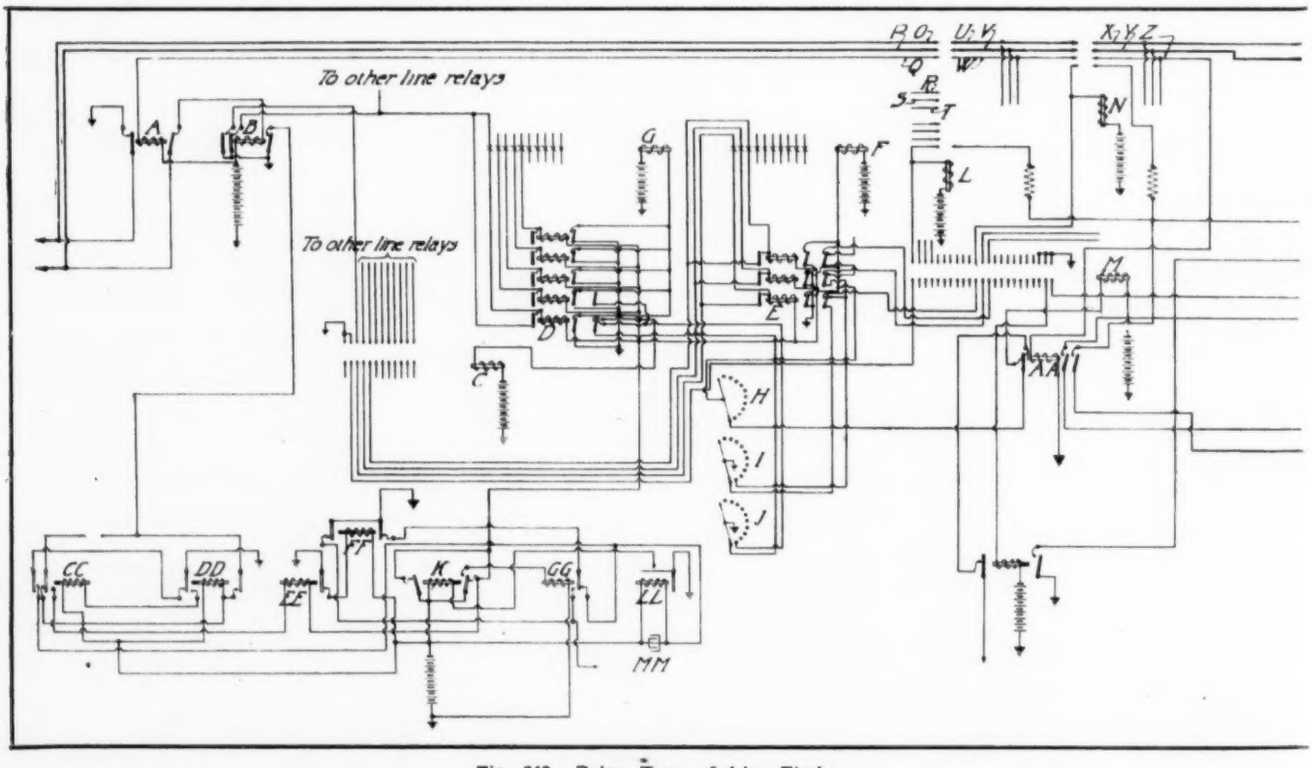


Fig. 319. Relay Type of Line-Finder.

1126. *The "off-normal" contacts.*—At the extreme right-hand upper corner of Fig. 320, there are shown four switch

wipers, 2, 3, 4, and 5. These are wipers of the first selector switch fixedly associated with the other trunk equipment shown. It will be noted that the two heavy lines representing conductors of the trunk circuit lead from the calling line through several relay contacts directly to first selector wipers 2 and 3.

The switch used with the circuit arrangement shown always travels first in a rotary sense and then in the vertical sense. When this switch takes the first rotary step, two normally-closed contacts at *P* are opened and the two springs are disconnected from the grounded or positive terminal of the common battery. When the rotary movement has ceased and the vertical movement begins, two normally-closed contacts at *R* and one at *Q* are opened. All of these normally-closed contacts, which are known as "off-normal" contacts, remain open as long as the switch is in any position *other than the normal at rest position.*

The operation of current-supply relay *B*, Fig. 320, completes a path for the flow of current through a relay associated with a secondary selection not shown, which corresponds in its operating function to the line relay *B* in the circuit shown in Fig. 319. This relay causes a selection to take place which effects a connection between the trunk to which the calling line has been connected and the operator's answering equipment. This secondary selection will be described in detail in a later chapter.

It is worthy of note that the circuit over which current is passed to the equipment making this secondary selection is controlled by the first selector off-normal springs *R*. In other words, this flow of current, originally established by the operation of current-supply relay *B*, is absolutely interrupted when the switch shaft takes its first vertical step.

1127. *The first motion of selector switches.*—The general requirements of all forms of mechanical switching in which two-motion switches are employed for exchanges serving more than 100 lines limit the control of the subscriber or operator, as the case may be, to the first motion of each successive selector. It will be remembered that the first selector is required to select the group corresponding to the first digit of the called line.

This digit is always represented in the first selector banks by a *row* of sets of bank contacts each one of which is associated with equipment providing access to a trunk circuit leading to the desired group. In the first selector shown schematically in Fig. 320, this group selection is made by the rotary motion of the switch wipers. The rotary magnet is shown at *M* and the vertical magnet at *L*. One terminal of the winding of each is connected to the negative or non-grounded terminal of the common battery. Around the terminals of the winding of each is connected a condenser.

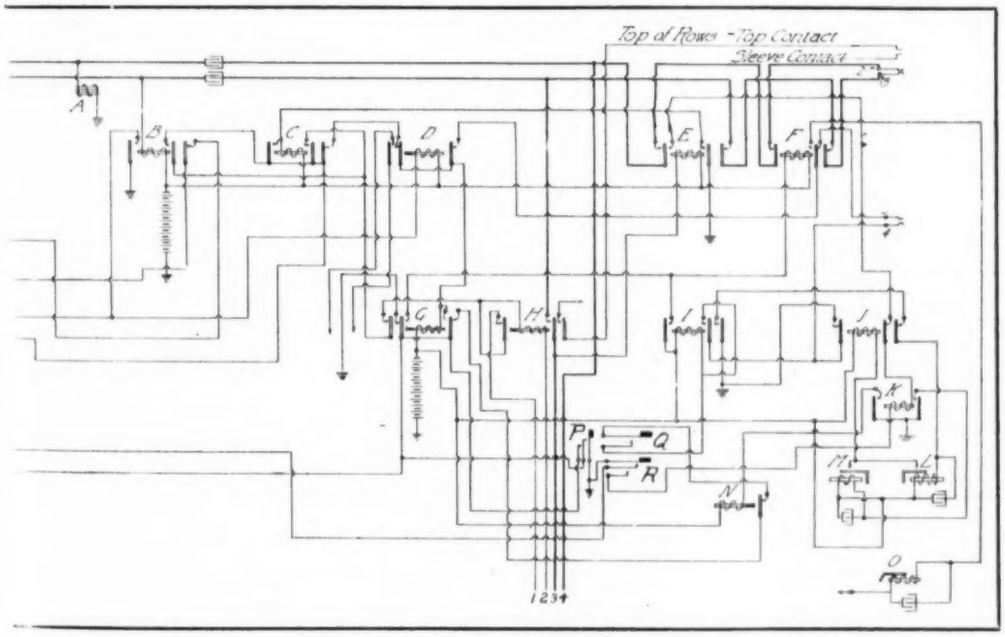


Fig. 320. The First Selector Circuit.

The effect of this condenser in parallel with the magnet winding is explained in a subsequent chapter when the mechanical structure of the switch is described. The briefest examination of the circuit will make it plain that whenever relay *K* is energized, and its armature operated, that the rotary magnet *M* will be energized and will step the switch shaft one step in the rotary sense. The circuit in which the winding of relay *K* is included may be traced as follows:

Starting at the positive or grounded terminal of the common battery, the circuit leads through the normally-closed off-normal contact springs at *R*, the winding of relay *K*, the normally-closed break contact of relay *J*, the normally-open make and break contact of relay *E* (shown normal or open), one conductor of the first selector trunk, and the tap 4, leading from this first selector trunk conductor to the operator's equipment.

It is obvious that when relay *E* is operated and current impulses are sent to the first selector trunk from the operator's equipment over wire 4, while relay *J* is normal, relay *K* will be intermittently operated and the switch shaft will be rotated.

As a matter of fact, this is the exact condition when the rotary steps of the first selector are being made. It is also plain that the operation of relay *K* will permit current to pass through the winding of slow-acting relay *N* causing it to retain its armature in the operated position throughout the series of rotary switch-driving impulses.

Assume that the first digit of the called number is four. In that event four switch-driving current impulses will be received from the operator's equipment over wire 4 and the switch shaft will be driven four steps in the rotary sense. During the time that these impulses are passing, slow-acting relay *N* will be energized and will retain its armature in the operated position. At the end of the series relay *K* will be released for a sensible period and the energizing series of impulses of current will be withdrawn from the winding of slow-acting relay *N* which will then release its armature at once.

1128. *The first vertical step.*—When slow-acting relay *N* releases its armature, a path is completed for the passage of current through the winding of relay *I* which is traceable as follows:

Starting at the positive or non-grounded terminal of the common battery, the current flows through one of the normally-closed make-and-break contacts of slow-acting relay *G*, the second normally-closed make-and-break contact of slow-acting relay *G*, the normally-closed break contact of slow-acting relay *N*, the normally-closed vertical off-normal contact sqrings *Q*, the winding of relay *I* and the common battery. It is to be noted that the circuit of the *rotary* magnet is now opened at the normally-open make contact of relay *K*.

As an immediate result of the flow of current in the circuit traced, relay *I* is operated and completes a circuit for a

WE CAN MEET ALL

With Strowger

PROMPTLY

When a telephone company needs an addition to its existing exchange, or decides to re-equip an old or worn out office, *speed* is of great importance.

One of the important services extended by Automatic Electric Company to its patrons — present and prospective—is prompt delivery and installation.

Volume production, greatly increased during recent months, better and more certain sources of raw material, enlarged space, more machinery and more workers make it possible for us to guarantee this service.

In placing orders for Strowger equipment you need not fear annoying delays, either on the initial installation or on additions.

Our increased staff enables us to place at the disposal of any company desiring to study Strowger equipment in connection with its requirements, competent and experienced engineers, without delay. The business of these men is to lay before you the *facts* upon which you can make a decision, and they will be glad to make such studies without cost or obligation to you.

AUTOMATIC EL

FACTORY AND GENERAL

BRAN

New York City
21 East 40th St.

Cleveland
415 Cuyahoga Bldg.

Philadelphia
The Bourse Bldg.

Columbus
516 Ferris Bldg.

ASSOCIAT

INTERNATIONAL TELEPHONE SALES

International Automatic Telephone Company, Ltd., London

Compagnie Francaise pour l'Exploitation des Procédés

OUR REQUIREMENTS

matic Equipment

COMPLETELY

Whether you need a 100 line unit or a 100,000 line multi-office system, Automatic Electric Company offers you a simple, time-tested, economical equipment, which insures minimum operating costs, and the highest grade of service.

You can convert your present exchanges, large or small, in whole or in part, knowing that you are adopting equipment which will be up-to-date, however long you operate it, and will earn sure and satisfactory profits for your company.

Have you a main exchange that is nearing the end of its effective life? We can point to hundreds of Strowger installations which will demonstrate what this equipment will do for you.

Are you operating small outlying exchanges, on a very narrow profit or none at all, where the service is not up to the standard you would like to maintain? Let us show you what the C. A. X. is doing for other companies which faced the same problem and have solved it successfully.

For all types of service, in exchanges of every size, Strowger equipment offers a simple, efficient and economical apparatus, and renders a service which is above reproach.

TRIC COMPANY

S: CHICAGO, ILLINOIS

CES:

Rochester 612 Mercantile Bldg. | Detroit 525 Ford Bldg. | Pittsburgh 608 Fulton Bldg. | Kansas City 1001 New York Life Bldg.

PANIES:

NEERING CORPORATION, New York

uston, Paris | Automatic Telephone Mfg. Co., Ltd., Liverpool | Automatic Telephones, Australasia, Ltd., Sydney

locking condition in its own winding until released by the operation of relay *J*. The operation of relay *I* completes a path for a flow of current through the winding of the *vertical* magnet *L* and the switch shaft is raised one step.

When the switch shaft has been raised one step, the wipers, 2 and 3, are in contact with the terminals of the first trunk circuit in the selected group while wipers, 4 and 5, are in contact with the corresponding test-bank contacts.

(*To be continued.*)

Keystone Telephone Co. Earnings for Month of June.

The Keystone Telephone Co., of Philadelphia, has issued its comparative statement of earnings for the combined companies for the month of June, 1921, and for the six months of this year ending with June 30, as follows:

	For month Ended June 30 1921	Year Previous
Gross earnings	$144,880	$144,630
Operating expenses and taxes	89,397	96,080
Net earnings	55,483	48,550
Less int. charges	38,483	36,887
Balance available for dividends, surplus and reserve	17,000	11,663

	For 6 months ended June 30, 1921	Year previous
Gross earnings	$868,277	$862,451
Operating expenses and taxes	599,023	557,340
Net earnings	269,254	305,111
Less int. charges	231,387	214,663
Balance available for dividends, surplus and reserve	37,867	90,448

Indianapolis Consolidation Work Going on Rapidly.

Rapid progress is being made in the consolidation of the automatic and manual telephone systems in Indianapolis, according to a recent report filed by the Indiana Bell Telephone Co. with the state public service commission. It is indicated that the company expects to have the work completed by fall.

"The major portion of outside plant work," said the report, "including conduit and cable work, is practically completed. There will be miscellaneous items of work on this type of plant up to the final consolidation, consisting of drop and cross-connection work, testing, etc. The work of equipping subscribers' instruments with the new type dials has been completed.

"Approximately 95 per cent of the P. B. X. switchboard material has been received. The balance due has not yet interfered with our work and is expected soon. About 80 per cent of this work has been completed. The central office equipment additions in manual offices were started February 17 and this part of the work is 75 per cent complete. The additions in the automatic offices were started on March 16, 1920, and this work is about 65 per cent complete. The engineers have practically completed their plans for the cut-over and the unification can be effected shortly after the installation of the central office equipment."

Commissions, Courts and Councils

Discussion and Rulings of State Bodies Having Supervision Over Telephone Companies—Decisions of Courts in Matters of Interest to Public Utilities and Actions of City Councils Relative to Franchise, Rates and Service

New Plan for Service and Maintenance of Rural Lines.

A new method of charging for rural telephones connected with the exchanges at Brownstown, Vallonia, Tampico, and Crothersville, which are operated by the Southern Indiana Telephone & Telegraph Co., is authorized by a recent order of the Indiana Public Service Commission.

The company is authorized to discontinue the charge of 50 cents a month for county connecting lines and to charge in lieu thereof $1.50 a month for all party-line service, and to pay subscribers for the rental of facilities 50 cents a month for full metallic lines, 25 cents a month for grounded lines and 25 cents a month for instruments. Such rentals are to be deducted from the monthly bills. In addition, the company has been authorized to charge 5 cents for each call originating in Jackson county and switched by it through the Brownstown exchange to any other exchange in the county.

The company is required to maintain in good condition all lines and instruments rented and make all replacements chargeable to depreciation, but to charge such sums to subscribers, or the subscribers may at their option make such replacements.

"The evidence shows," the order reads, "that the present arrangements by which part of the lines are owned by the petitioner and part by the subscribers is very unsatisfactory in that it leads to many controversies over the maintenance of said lines. This is shown not only by the evidence of the petitioner but by the evidence of the respondents. A permanent solution of these difficulties cannot be obtained until the responsibility for the maintenance of these lines is centralized with the petitioner. If petitioner is to assume the responsibility for the maintenance of the lines, it must receive additional remuneration for it.

"There can be no doubt that the present arrangement is thoroughly bad from the point of view of service and responsibility for maintenance; and that the rate which is paid for such services is less than the cost of the service, and therefore discriminatory as compared with the other rates charged by the petitioner. The audit also nearly shows that petitioner's present rates do not yield a fair return, and that rate relief should come from such classes of subscribers as are not now bearing their full part of the revenue burden.

"The commission is of the opinion that it is highly desirable that all of these lines should be owned by and maintained by the petitioner. However, it has no power to require the purchase of these lines or to require respondents to sell same to petitioner, although it is of the opinion that the rural subscribers would find it decidedly to their advantage to do so. The commission also is of the opinion that it is highly desirable that these lines be made metallic in order to render more efficient service. However, it cannot concur in the petitioner's position that no rental should be paid for such lines until they are metallic nor can it order said subscribers to rebuild said lines."

Maine Commission Hits at "Listening-in" Practice.

The Maine Public Utilities' Commission has issued a decision granting the proposed schedule of increased rates asked by the Half Moon Telephone Co., which renders service in the towns of Thorndike and Freedom and in parts of the towns of Knox, Montville and Unity.

These rates were filed with the commission on April 2, last, to become effective on June 1, 1921. Complaint was received from patrons and the commission suspended the effective date for three months, ordering a hearing for June 14 in Thorndike, which was held.

The commission in its order, says:

"While the quality of the service is fairly good, many causes of complaint exist and many interruptions of service occur. Some of these arise from causes which can and ought to be removed by the company; others from causes beyond control of the company and can only be remedied by the active co-operation of the patrons themselves.

"This is notably the case in regard to the very great annoyance and inconvenience

caused by the 'listening-in' on the party lines. This practice is one of the most prolific causes of poor service in this as well as in many other telephone companies.

"We believe that this cause of complaint can be quite largely eliminated, if the subscribers, themselves, will co-operate with the officers of the company with that end in view. If the people who persist in this practice can be made to feel the weight of an indignant and outraged public opinion, they will not long indulge in it."

The commission urges the importance of repairs to pole lines and wires.

The effective date of the new rates is October 1, 1921.

Kansas Commission Restrained from Putting Order Into Effect.

Judge George H. Whitcomb of the district court at Topeka, Kans., on July 25 issued an order temporarily enjoining the Kansas Public Utilities Commission from putting into effect its recent order regulating the rates of the Southwestern Bell Telephone Co. in the towns of Hutchinson, Arkansas City, Eldorado, Lyons, Winfield and Atchison.

The action of the district court sends the case, which the telephone company brought against the utilities commission, back to where it was before the commission issued its rate order affecting the six towns June 24, and leaves the company free to use its own rates in accordance with the injunction issued last March by Judge James A. McClure.

In the event that the rates to be decided upon finally are not so high as the rates being charged at the present time, the telephone patrons will be protected as Judge Whitcomb ordered the telephone company to put up a bond of $100,000 which may be used to giving rebates.

A hearing of the company's application for a permanent injunction against the commission's order will be held in September.

Osceola (Mo.) Telephone Co. to Put in New Rate Schedule.

The Missouri Public Service Commission, July 28, in the case of the Osceola Telephone Co., of Osceola, ordered that the order of suspension issued June 6, 1921, be vacated and rate schedule known as P. S. C. Mo. No. 2 be accepted and the company allowed to put in force the rates contained in it, September 1 for a period of 13 months.

The company was further ordered to file a sworn report of its revenues and expenses for its exchange at Osceola at the expiration of a six months' period and 12 months' period after September 1. The reports are to contain a list showing expenses for labor and materials used in repairing the plant and putting the lines and other equipment in a serviceable condition.

Reports showing expenses incurred in making necessary improvements on the plant must show at least $65 a month has been expended for the purpose named. If the company fails to make such a showing, the commission will issue orders necessary to restore rates now being charged by the company.

Missouri Supreme Court Declares Service Charges Legal.

In a recent letter to members of the Missouri Telephone Association, Secretary Claude D. Long says that the association is preparing to again bring before the Missouri Public Service Commission the matter of installation and move charges.

The commission ruled against them and the matter was appealed to the state supreme court by the Southwestern Bell Telephone Co., the association filing an intervening petition.

The court, in deciding the case, ruled that the installation and move charge was a legal charge. There were two separate concurring opinions. One written by Judge Graves, which was concurred in by Judges Higbee and Woodson, and another separate concurring opinion on motion for rehearing, was written by Judge Elder.

Judge Graves in his opinion, says among other things, that, "It is said that the installation charge is discriminatory against the short-term user of a telephone, in that it requires him to pay more for the service which he receives. In my judgment, the failure to allow such charge discriminates against the long-term user of the telephone, and to obviate such discrimination, reasonable charges for installation, removal, etc., should be sanctioned by the commission."

Judge Elder says among other things: "In order to clarify the subject somewhat, I add to my concurrence the view that such charges, when just and reasonable, are neither discriminatory nor unlawful."

This makes the majority of the court legalizing, and saying in other words to the commission, that the installation and removal charge is not an unlawful charge.

Goodbye to $1 a Month Rate—$1.25 Now.

Effective August 1, 1921, the Independence Telephone Co. was authorized by the Wisconsin Railroad Commission to increase its rates for telephone service from its old rate of $12 per year to a rate of $15 per year for all subscribers.

The Independence Telephone Co. furnishes telephone service to 264 subscribers who are located at the village of Independence and the territory tributary thereto. The system is grounded and is composed of 64 miles of poles and 135 miles of wire. One exchange is maintained at Independence equipped with a magneto switchboard to which 60 lines are connected. The book value of the plant and property as shown in the 1920 annual report amounts to $7,280. This figure represents an investment of only $27.59 per subscriber, which is below the average found in appraisals of plants comparable to this one.

Increased Rates in Louisiana to Stand Pending Hearing.

People of New Orleans and throughout Louisiana must continue to pay the increased telephone rates granted the Cumberland Telephone & Telegraph Co. by the old railroad commission at Baton Rouge, February 26.

The Louisiana Public Service Commission, which is the new name of the railroad commission, on July 26 decided against putting the rates back to the old figure pending a hearing to be held in October or November.

Huey P. Long, of Shreveport, who originally opposed the increase in rates granted the telephone company introduced a resolution before the commission asking that the high rates not be collected until the people are given a hearing.

Mr. Long forced a vote on his motion and Shelby Taylor, chairman of the commission and John T. Michel, the New Orleans member, voted against any reduction in rates pending the rehearing.

Mountain States Company to Raise Rates in New Mexico.

Exchange rate increases that will bring $20,000 additional annual revenue are listed in schedules, effective on September 1, filed with the New Mexico Corporation Commission July 29, by the Mountain States Telephone & Telegraph Co.

The company says these will not cover the deficit which for 1920 was $53,000, based on 8 per cent return, although toll rates were increased during the year.

The Albuquerque residence rate for one, two, three and four-party service is raised 25 cents per month and in Santa Fe and Roswell the one-party residence rate is raised 25 cents.

Clovis and Las Cruces get 50-cent raises in one and two-party business rates and the one-party residence rate. The two-party residence rate is raised 25 cents at these exchanges.

The one-party residence rate is raised 25 cents and four-party residence service established in place of the two-party service at tthe same charge in Deming and Tucumcari.

For the following Class A exchanges, the one-party business rate is increased 50 cents, the one-party residence rate 50 cents, and four-party residence service established at $2:

Alamogordo, Belen, Barnalillo, Cimarron, Hagerman, Lake Arthur, Los Lunas, Portales, Santa Rosa, Springer, Texico and Tularosa.

The one-party residence rate is raised

50 cents and four-party service established at $2 for Artesia, Carrizozo, Fort Sumner, Magdalena and Socorro and the two-party business service for Socorro and Magdalena annulled and the $60 combination rate at Artesia eliminated.

The business rate is made $3.50 and the one-party residence rate $2.50 and the four-party service established at $2 for San Antonio and San Marcial and the business rate increased 50 cents at Farmington and Aztec.

Oregon Company Gets Rate Raise Applied to Efficient Service.

In an order issued June 28, the Public Service Commission of Oregon authorized the Coos & Curry Telephone Co. to place in effect July 21 at its Coquille exchange the following schedule of monthly rates:

Unlimited Business Service:	Old Wall	Desk	*New Wall Set
Individual line	$2.50	$2.75	$3.00
Party line 2-party.	2.00	2.25	2.50
Unlimited Residence Service:			
Party line, four-party.	$1.50	$1.75	$2.25
Individual line	2.00	2.25	2.50
Party line 2-party	1.75	2.00	2.00
Party line 4-party	1.50	1.75	1.75
*For desk type instrument add.			.25

The company's application for increased rates was made on the grounds that it was at a large expense installing a modern telephone system in Coquille, and that it was necessary to receive the increase in order to carry the large investment incident to these improvements.

At the present time the company's system consists of eight central office exchanges located in Coos, Curry and Douglas counties. In the city of Coquille the company has 262 subscribers. A modern exchange building and warehouse has been constructed and modern and efficient harmonic ringing common battery equipment and apparatus is being installed. Pole lines are being rebuilt and additional cable facilities provided. The estimated cost of improvements is approximately $19,000.

As evidenced by resolutions passed by the Coquille Commercial Club and the Coquille City Council, approving and accepting the increase in rates for change in service, and a petition signed by practically all the subscribers in Coquille requesting more efficient service and sanctioning the increase in rates, together with a statement at the time of the hearing by the city attorney of Coquille that upon the installation and completion of the new equipment the city would be willing to pay the additional rental, the commission held it clear that the increase met with the approval of those most vitally affected provided more satisfactory service was rendered.

Southwestern Bell Given Increased Rates in Tulsa, Okla.

On July 30, the Oklahoma Corporation Commission granted the Southwestern Bell Telephone Co. an increase in rates in Tulsa, effective August 1.

Under the commission's order, the rate on business telephones is increased from $6 to $7 a month. A flat rate of $3 for straight line residence telephones was substituted for the old zone rates ranging from $2.75 to $3.50 a month, according to the distance from the telephone exchange building. Under the old rate all telephone users within a radius of one mile from the office at Fourth street and Boston avenue were charged $2.75 while residents outside of this distance were charged 25 cents extra for each half mile or fraction thereof they were beyond this limit.

One party residence lines increased from $2.75 to $3. One party residence measured service, $2 to $2.25; two-party residence, remains unchanged at $2.50; business extension stations $1.25; private branch exchange trunks, one way, $7, two-way, $10.50.

The commisson refused an extra rate of 50 cents for telephones in West Tulsa. Rates of $2.50 for party lines remains unchanged.

The increased rates, it is estimated, will bring a revenue of $755,818 a year allowing seven per cent net profit or 12.96 per cent gross profit on the company's $1,574,052 investment, estimated as of June 30, 1921.

An immediate request for an injunction to prevent the rates going into effect will be made by the city of Tulsa, it is stated.

Rates Are Higher in Ladysmith, Bruce, and Prentice, Wis.

Increases in telephone rates, somewhat lower than those petitioned for, were granted the Chippewa Valley Telephone Co. for its Ladysmith, Bruce and Prentice, Wis., exchanges by the state railroad commission in an order handed down June 30. The old monthly rates compare with the new which cover service within a radius of one mile from the central office as follows:

Ladysmith Exchange: Business—Unlimited Service:	Old.	New.
One-party	$2.50	$3.00
Two-party	2.00	2.50
Extension telephone	1.50	1.00
Plus charge per month for each ⅛ mile line or fraction thereof on stations located outside premises	.25	.40
Residence—Unlimited Service:		
One-party	1.75	2.25
Two-party	1.50	1.75
Four-party (divided ringing)		1.65
Extension telephone, wall or desk set	.60	.75
Plus charge per month for each ⅛ mile line or fraction thereof on stations located outside premises	.25	.40
Rural rates for subscribers—within six miles from central office	1.50	2.00
With $3 per annum additional for each mile or fraction thereof beyond.		
Switching service	.25	.50
Bruce Exchange:		
Business Service—Unlimited:		
One-party	1.50	2.50
Two-party	1.50	2.00
Extension telephone	.60	1.00
Plus 40 cents per month for each ⅛ mile line or fraction thereof on stations located outside premises.		
Residence Service—Unlimited:		
One-party	1.25	1.75
Two-party	1.25	1.50
Four-party divided ringing.	1.25	1.25
Extension telephone, wall or desk set	.65	.75
Plus 40 cents per month for each ⅛ mile line or fraction thereof on stations located outside premises.		
Rural rates for subscribers connected with rural lines within six miles from central office		2.00
With $3 per annum additional for each mile or fraction thereof beyond.		
Switching service:		
Amacoy Telephone Co. Bruce		
Murray Farmers' Telephone Co., Bruce		
Charge per subscriber per month		.50
Prentice Exchange:		
Business—Unlimited Service:		
One-party	1.75	2.50
Two-party	1.50	2.00
Extension telephone	.65	1.00
Plus 40 cents per month for each ⅛ mile line or fraction thereof on stations located outside premises.		
Residence—Unlimited Service:		
One-party	1.00	1.75
Two-party	1.00	1.50
Four-party (divided ringing)	1.00	1.25
Extension telephone, wall or desk set	.65	.75
Plus 40 cents per month for each ⅛ mile line or fraction thereof on stations located outside premises.		
Rural rates for subscribers connected with rural line within six miles from central office		2.00
With $3 per annum additional for each mile or fraction thereof beyond.		
Switching service:		
Prentice Mutual Telephone Co., charge per subscriber per month		.50

Approximately 1,363 subscribers are served from these three exchanges. A tentative value of $68,000 was used by the commission in fixing the foregoing rates.

Telephone Rates to Be Raised in Cornell, Wis., August 1.

The Cornell Telephone Co. was authorized by the Wisconsin Railroad Commis-

sion on July 15 to increase its rates for telephone service within a radius of one mile from the central office as follows:

	Old	New
One-party business unlimited.	$2.50	$3.25
Two-party business unlimited.	2.00	2.75
Four-party business unlimited	...	...
Receiving business line	...	...
Business extension telephone..	.75	1.00
Plus 40 cents per month for each ⅛ mile line or fraction thereof on stations outside premises.		
One-party residence unlimited.	1.50	2.00
Two-party residence unlimited	...	1.75
Four-party residence divided ringing	1.25	1.50
Residence extension telephone.	.75	.75
Rural rates for subscribers connected with rural line.. within six miles from central with $3 per year additional for each mile or fraction beyond.	1.25	2.00

The Cornell Telephone Co. serves the village of Cornell and surrounding territory. It first gave service through its exchange in 1913, operating in competition with an exchange owned by the Chippewa County Telephone Co. which had been rendering service in the village since 1904. The distribution of the Cornell company's subscribers is unusual for a village such as Cornell. Because of various forces entering into the competitive struggle the company has 81 local and 5 rural subscribers whereas the Chippewa company serves most of the rural subscribers in the surrounding country.

The book value of the plant and property of the company as shown in its report for the year ending December 31, 1920, was $5,802.93. The total operating revenue for this period was $2,089.89 and the total operating expenses were $1,972.88, leaving available for depreciation and return on the investment a balance of $117.01. The new rates are authorized to become effective for service rendered on and after August 1.

Wisconsin Telephone Co. Asks Rate Raise in Milwaukee.

Application for a revision of residence telephone rates in Milwaukee which would grant an increase of from 50 cents to $1.25 a month has recently been submitted to the Wisconsin Railroad Commission by the Wisconsin Telephone Co. Discontinuance of one, two and four-party coin box service is asked.

"This step has been reluctantly decided upon and has been postponed until its necessity is imperative, if the service is to be maintained at its present efficiency," said W. R. McGovern, vice-president and general manager of the company in discussing the application. "In most other large cities this step was forced during or emmediately after the war.

"The average cost of operation has grown 50 per cent in 1921, as compared with 1914. The last change in residence rates was in 1916, when they were lowered. There has been some reduction of wages by other companies. The cost of living now is about 50 per cent higher than in 1914. We feel that our employes are entitled to a fair wage and that our subscribers are willing to pay a fair rate to enable us to pay a fair wage.

The Wisconsin Telephone Co. has tried to serve the public faithfully. The average dividend over 40 years is less than 8 per cent. With the proposed increase, we will earn only 5¼ per cent on our investment. It is a plain case of necessity for more revenue to meet the growing operation costs of a business that has extended with unexampled rapidity during the last seven years.

A large telephone business reverses the normal rule that the larger the business the more cheaply the goods can be sold. In 1914, when there were 52,000 telephone stations in Milwaukee, each subscriber could talk to the other 51,999. Now 84,000 subscribers can talk with each other and the total traffic possibilities are nearly tripled, not merely doubled. The progression is geometrical, not arithmetical."

Recognize Increase in Operators' Wages in Raising Rates.

In granting an increase in rates to the Wisconsin Telephone Co. for its Madison, Wis. exchange, the state railroad commission takes into consideration the fact that the company's operating ration increased from 52 per cent in 1915 to 92.4 per cent in 1920, due principally to increased operators' wages.

The company's operators' wages in 1915 totalled $2.55 per station, while in 1920 they were $6.10 per subscriber station. This is equivalent to an increase of 139 per cent in operators' salaries during the period of six years. In comparison, the total operating expenses per telephone for this period increased from $9.42 per station to $17.10 per station or 1.5 per cent.

The Wisconsin Minimum Wage Law, fixing a specified amount as the minimum to be paid operators, is reflected to some extent in the large increase in salaries paid the operators. The railroad commission made the following statement on the question of wages being reduced:

"It is not probable that the wages of operators, linemen, repairmen, and other skilled telephone labor will show material decrease in the near future. The tendency, in fact, may be the other way. The recent decision of the industrial commission which fixes the minimum wage to be paid women in cities over 5,000 population at 25 cents per hour in lieu of 22 cents formerly paid may be reflected to some extent in the salaries paid the Madison exchange operators, although all salaries now paid are above the required minimum.

"With the legal requirements tending to increase the salaries of certain classes of employes, it is not probable that any reduction can be made in the salaries of other classes of employes, where quite definite differentials have been previously established between the salaries paid to the different groups."

Expense Statement Shows Need for Higher Switching Rates.

The Luxemburg Telephone Co. was recently authorized by the Wisconsin Railroad Commission to increase its switching rates, effective July 1, from $3.25 per telephone per year to $5 per telephone per year for all telephones switched for the Montpelier Telephone Co. and the Casco-Luxemburg Telephone Co. The Luxemburg company alleged that the actual cost of operating each telephone was $6.79 per year and presented the following list of expenses in substantiation of the cost of switching:

Central office expense.....	$2,143.44
Interest on office equipment.....	77.00
Interest on building, $3,000 at 7 per cent	210.00
Insurance on building and equipment	25.00
Depreciation on building and equipment	246.00
Taxes	111.22
Actual cost of operating 414 telephones	$2,812.66
Cost per telephone per year...	$6.79

In its decision the commission stated that "the method used in determining the cost of switching per telephone assumes that the calling rate is the same for all classes of service and that the expenses should be equally divided between telephones. This is not the case, however. The demands on the operator's time by various classes of service are very different and some expenses, such as maintenance of switchboard, should be apportioned over the number of lines rather than over the number of telephones.

"On the basis of a traffic study furnished by the company we have estimated the proportion of the operator's time used by the switched subscribers and find it to be 16.25 per cent. This is much less than the average of 30.9 per cent as presupposed by the company's figures. From our study, using the same expenses as used by the company, we have determined that the cost per switched telephone is slightly less than $5 per year."

Investigation of Service of Wisconsin Company Dismissed.

Under date of June 27, the Wisconsin Railroad Commission handed down its decision dismissing the investigation on its own motion of the service and practices of the Central Wisconsin Telephone Co. This case arose from an informal complaint by Alton Nolop, of Hixton, to the effect that the service and practice of the Central Wisconsin Telephone Co. in and about Hixton in Jackson county were unreasonable.

This company operates a telephone ex-

change at Hixton, and number of co-operative farmer telephone associations have also maintained an exchange at this point. The Curran Farmers Telephone Co., a corporation which owned five party lines and a through line between Hixton and Taylor, sold its property to the General Wisconsin Telephone Co. The latter company then disconnected these lines from the farmers' exchange and has since furnished the subscribers thereon service from its Hixton exchange.

The property of the Farmers' Telephone Co. Line 8, an unincorporated mutual company, was also taken over by the Central Wisconsin Telephone Co. at a price agreed upon between it and the majority of the members of the former company. This line also was disconnected from the farmers' switchboard and connected with the Central Wisconsin Telephone Co. exchange. After the withdrawal of these two companies the remaining farmer lines discontinued the operation of their Hixton exchanges because it was believed that the cost of operating was too great. These lines did not have a connection with any other exchange and were therefore left without service except for communication with other parties on the same circuit.

Mr. Nolop's chief complaint appears to be that the sale of the Farmers Telephone Co. Line 8 was not a lawful transaction. The commission pointed out in its decision that it was not the proper tribunal for the determination of that issue. The Central Wisconsin is in possession of and is operating the property and, until the courts determine otherwise, it must be recognized as the actual operating utility for the purpose of regulation. The commission also pointed out that the various farmers lines could resume the operation of their exchange at any time they desire, and that if they desired to have the Central Wisconsin perform their switching, such an arrangement could doubtless be made and the rates for that service subject to regulation by the commission.

In view of all the facts presented, the commission was unable to find that affirmative action on its part was required, and therefore dismissed the case.

Summary of Commission Rulings and Hearings.

CALIFORNIA.

August 2: Orders of dismissal were entered by the commission in the cases of J. O. Davis against the Pacific Telegraph & Telephone Co. and the Westport Rural Telephone Co., and the application of the Manteca Telephone & Telegraph Co. for a rate increase.

IDAHO.

July: Stites-Kooskia Telephone Co. in Idaho county granted increase in rates ranging from 33⅓ to 50 per cent.

ILLINOIS.

July 13: Order issued resuspending until January 27, 1922 proposed advance in rates by the Central Union Telephone Co. for service in Alton and Wood River.

July 19: Order issued resuspending until January 27, 1922 proposed advance in rates for telephone service rendered by the Central Union Telephone Co. in Edwardsville.

July 19: Order resuspending until January 17, 1922, proposed advance in rates made by the Edgington Central Telephone Co. for service in Edgington.

July 19: Harrisonville Telephone Co. authorized to make certain changes in rates for telephone service in Waterloo, Valmeyer and Columbia, county of Monroe, Red Bud, and Prairie du Rocher; county of Randolph and Dupo, county of St. Clair, as stated in rate schedule IPUC 1, covering local telephone service, and IPUC 2, covering toll telephone service, all specifically set forth in order.

July 19: La Harpe Telephone Co. ordered to suspend until November 30, 1921, proposed advance in rates for service in LaHarpe, county of Hancock, and vicinity.

July 19: In re Myer J. Stein vs. Illinois Bell Telephone Co., an order was issued denying petition filed July 1, 1921, for rehearing in case.

July 20: An order approving the sale by the shareholders of the Ray, Houston & Rushville Telephone Co. to the Ray, Houston & Rushville Mutual Telephone Co. issued. Certificate of convenience and necessity granted Mutual company. Company to file within 10 days from date of transfer of property, a schedule of all toll and local rates now in effect, and authorized to issue capital stock in the aggregate amount of $1,020.

July 20: El Paso Telephone Co. authorized to issue and sell first mortgage 7 per cent bonds, dated December 1, 1920, in the aggregate amount of $5,000 interest 7 per cent per annum. Au. No. 1231.

July 21: Order issued suspending until January 20, 1922, proposed advance in rates by the Illinois Bell Telephone Co., for service in Kankakee.

August 2: Proposed advances in telephone rates in Peoria, Averyville, East Peoria, Bartonville, and Peoria Heights, suspended until February 23, 1922.

KANSAS.

July 29: Kansas City Telephone Co. operating exchanges at Vance and Bethel, withdraws application for increased rates.

MAINE.

July 28: Half Moon Telephone Co. allowed increase in rates in Thorndike and Freedom and in parts of the towns of Knox, Montville and Unity. They become effective October 1.

MISSOURI.

July 23: Rates of the Kansas City Telephone Co. of Kansas City, extended from August 1.

July 28: Osceola Telephone Co., of Osceola, authorized to put into force rate schedule P. S. C. Mo. No. 2, for a period of 13 months, effective September 1.

MINNESOTA.

August 16: Hearing at Cyrus on the application of the Cyrus Mutual Telephone Co. for authority to increase rates.

NEBRASKA.

August 1: Complaint filed by W. V. Barton against the Lincoln Telephone & Telegraph Co., alleging generally unsatisfactory service.

August 2: Complaint filed by Peter Buell, of Lexington, against the Northwestern Bell Telephone Co., alleging that he was unable to get service because of bad order conditions.

August 2: In the matter of the application of the Stanton Independent Telephone Co. for permission to charge gross and net rates; request found to be reasonable and in accord with usual custom of the commission, and permission granted.

August 3: Complaint filed by A. L. Morris against the Wauneta Telephone Co. alleging that he was unable to secure satisfactory service on toll connections to Benkleman.

August 3: In the matter of the application of the Arcadia Light & Telephone Co., for permission to permanently increase rates; hearing held at Arcadia; appearances for company, J. L. Wait, owner; evidence adduced and cause taken under submission. It was at Arcadia that an effort was made to get an agreement of farmer patrons to refuse to pay increased rates any longer, but it apparently failed.

August 4: Complaint filed by Palmer Land Co., of Omaha, against the Northwestern Bell Telephone Co., alleging delay in giving service.

NEW MEXICO.

July 29: Mountain States Telephone & Telegraph Co. filed rate increase effective September 1.

NEW YORK.

July 29: Proposed rates of Rochester Telephone Corp., to be effective Aug. 1, ordered suspended.

August 4: Complaints of city of Syracuse against New York Telephone Co. dismissed.

August 5: State Telephone Co., of Coxsackie, under tariff filed with commission, proposes as effective on September 1, new rates in the Coxsackie and Ravena central office districts and territory service therefrom.

August 25: City of Rochester to have rehearing on order of commission permitting, in part, metered telephone service in that city.

NORTH DAKOTA.

August 1: New rates granted Groggs County Farmers Co-operative Telephone Co., Cooperstown, N. D.

August 1: Golden West Telephone Co., Dodge, N. D., granted authority to issue $5,000 capital stock.

August 1: Application of Citizens Telephone Co., of Bathgate, N. D., to extend certain farm lines granted.

September 21: Hearing at Northgate on the petition of Farmers & Merchants Telephone Co., of Flaxton, to close the Northgate exchange.

OKLAHOMA.

July 30: Southwestern Bell Telephone Co. granted increase in rates in Tulsa, effective August 1.

August: Broken Arrow Telephone Co. granted an increase in rates effective August 1.

OREGON.

June 28: Coos & Curry Telephone Co. granted rate increase at Coquille exchange, effective July 1.

WISCONSIN.

July 30: The Marshfield Telephone Exchange given authority to issue $10,000 of its capital stock of the par value of $100 per share for the purpose of securing funds with which to pay for additions and extensions to its property and plant, to pay indebtedness due July 1, 1921, and all for purposes properly chargeable to capital account.

August 8: Hearing at Madison on the complaint of the Deerfield Telephone Co. vs. Cambridge Telephone Co. regarding the construction of a clear line between Deerfield and Cambridge. U-2550.

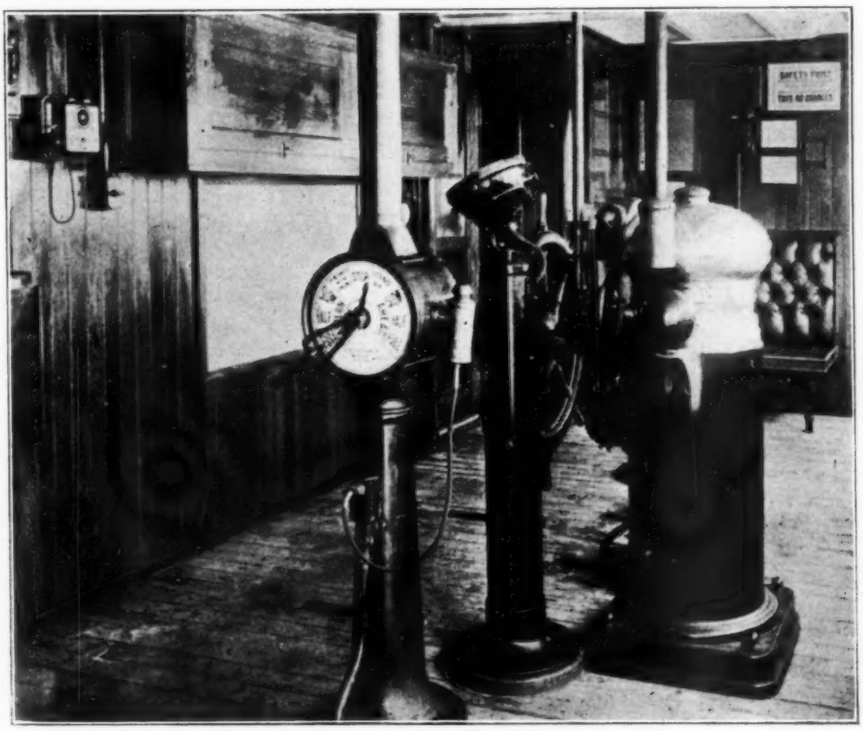
August 10: Hearing at Madison on the application of the Eastern Wisconsin Telephone Co. for authority to increase its rates at New Holstein Private Branch Exchange. U-2555.

Practical Talks—What's Your Pet One?

Telephone Equipment on New Trans Pacific Liners.

One of the most interesting features of the new combination freight and passenger steamers built by the United States Shipping Board and assigned to the Pacific Mail Steamship Co. for operation in its trans Pacific service and the Manila-East India service is the completeness of the telephone service.

There will be five of these steamers placed in the trans Pacific service and three in the Manila-East India service. The trans Pacific steamers are known as the "535" type and each is equipped with a complete telephone system with a central exchange and telephones in each stateroom. Never before has any steamer operating on the Pacific Ocean been equipped with such facilities.



This Equipment Will Render Telephone Service Complete on Great Liners.

On the trans Pacific steamers and the Manila-East India line intercommunicating telephone systems have been installed with a telephone located at the head of the captain's berth enabling that officer to be in constant communication with all parts of the ship during the time that he occupies his berth, thus eliminating the necessity of his arising when he desires to use the telephone or when he is wanted on it.

In the pilot house and on the flying bridge, there are installed Sperry gyrocompasses. These compasses are controlled by a master-gyro-wheel located in a special room opposite the engine room. In order to insure the operation of these very important instruments, a special telephone system has been installed with individual telephones in the master gyro-wheel room, and on the flying bridge and in the pilot house. Thus telephones are not only installed for the convenience of the passengers but also for their safety.

Railroads Experiment with Welding Iron Wire Joints.

In order to reduce and stabilize the resistance for telegraphic purposes and to balance the transmission for telephonic usage, experiments have been made to determine the mechanical and electrical effects and the cost of welding iron wire joints. The mechanical and electrical efficiency of joints in corroded iron wire may in some instance be increased over 100 per cent by electric or gas welding.

The Hocking Valley Railroad removed 250 ohms from each of two telephone circuits and the Zanesville & Western Railroad removed 500 ohms from a telephone circuit by welding iron wire joints with an oxyacetylene flame.

Experiments by the U. S. Bureau of Standards indicate that the tensile strength of the unwelded iron wire joint made in the usual way is 50 per cent of the unspliced wire and that the welded joint is 9 per cent stronger than the unspliced wire. The resistance of a welded joint is 95 per cent of that of an unspliced wire, while the resistance of the usual soldered joint is 112 per cent of the unspliced wire. The resistance of an unsoldered joint was found to be about 200 times as great as the same length of unspliced wire.

Two ends of the wire on either side of the existing joint are drawn together and clamped with sufficient slack to insure against strain on the joint during the welding. The weld is made by heating the neck of the joint to a fusing heat with a welding torch, using a No. 2 tip, and then flowing a small quantity of welding wire to increase the diameter of the wire 1-16 inch.

The torch should be used to burn off any galvanizing that may remain on the wire. No. 9 ungalvanized scrap iron wire should be used for welding No. 8 iron wire. After the weld is made, it is advisable to paint the joint with red lead to prevent corrosion.

This work was performed with an oxyacetylene flame at a cost varying from 26 to 40½ cents per joint. Gasoline or kerosene-driven electric generating outfits of 0.6 or 0.8 k.w. capacity can be used for welding. The cost is not excessive, and the work, when completed, is of a permanent nature.

Night Telephone Service for Motorists in England.

The automobile association has installed over 50 sentry boxes along the main roads of England, in which are fitted telephones for the use of members. During the past 18 months members have been provided with special keys, enabling them to open the boxes and use the telephones at night time, after the A. A. road patrol in charge has gone off duty.

To enable members more easily to locate these telephones after dark, the association, says the Manchester Guardian, has for some months past experimented with systems of illumination. The first roadside telephone box to be illuminated is that situated on the Epsom Road, near Ashstead. The association has decided similarly to illuminate the telephone signs attached to all the roadside telephone boxes, except where the boxes are well indicated by public lighting services.

Choosing a Screw Driver That Is Suitable for the Work.

In selecting a good screwdriver for repair work choose one with a handle which is well made and on which a good grip can be secured. For electrical work,

wood or rubber makes good handles. If the screw driver is to be used as a chisel, the blade should project through the handle.

In regard to the blade itself, it should be riveted securely to the handle and should be of a good quality of steel, possessing a great deal of elasticity. The blade should be tempered somewhat, but should bend instead of breaking. The edge will be cut and useless if the blade is not harder than the screws it drives.

The point of a screw driver should, of course, be shaped for the work which the tool is to do. For instance, for securing wood screws in cabinet work, a rather narrow pointed blade would be used. For heavy machine work, a shorter, thicker and wider blade would be the one to employ. Never have the blade ground to a thin knife edge, as the tool then acts as a wedge and slips out of the slot of the screw.

For a short distance back from the point, the two sides should be almost parallel, and the point should be blunt, though narrow enough to go into the slots of the screws. It may be necessary to have three or four screw drivers with blades of different widths, where many different sizes of wood screws are used. Generally speaking, a screw driver should be used in which the width of the point and the length of the slot in the screw are the same. Usually screw drivers with long blades lift screws easier than short blade drivers.

Getting Pay for Farmers' Long Distance Calls.

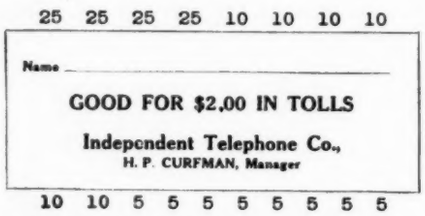
A scheme has been devised by H. P. Curfman, manager of the Independent Telephone Co., of Towner, N. D., for getting farmers to pay for their long distance calls in advance. By this method, he says, he does not have to pay his farmers' long distance toll bills out of his own money.

He had toll tickets printed, like that in the accompanying illustration, and notified his farmers that if they wanted to receive any long distance service they would have to buy a toll ticket and pay for it in advance.

The farmer keeps one ticket and Mr. Curfman keeps one in his office with the man's name upon it. When the farmer puts in a long distance call, he asks the operator for the amount of the call and this amount he marks off on his ticket. In this way he can tell when his ticket is run out and when he has to buy a new one.

When the farmer's bills come into the office at the end of the month, Mr. Curfman also punches his duplicate tickets for the amounts of the bills, marks the bills paid, and files them away. At the end of three months, he mails these bills to the farmer so that he can check up his own toll ticket.

Since starting this plan two years ago, Mr. Curfman says that he has lost very little money paid out for toll calls for farmers. The farmer who does not have a toll ticket, does not receive any long distance service unless he calls some one in town who has a telephone to stand



Card Used for Getting Farmers to Pay for Toll Calls in Advance.

good for the call. Toll is then charged to the telephone of the subscriber who stands good for the call. All of Mr. Curfman's operators have a list of the farmers who have toll tickets.

The Switchboard Cord and An Outline of Its Development.

The first type of cord used for switchboard purposes was made of braided tinsel conductors, with one of the conductors uninsulated. The conductors lay parallel in a brass wire spiral which was protected by an outside braid.

The cords were very flexible and had low resistance. Owing to the braided tinsel conductors, however, the ribbons of tinsel cut into adjoining layers of tinsel, wherever they crossed each other, every time the cord was used.

The strain of the cord weight when the plug returned to its seat was taken up almost entirely by the tinsel strands, because the outside cotton braid was resilient, also the brass spiral and the cotton braiding on the conductors.

As a result of constant cutting, rubbing, and stretching, the ribbons of tinsel became broken long before the life of the cord was reached, and the ends of these ribbons would be rubbed against one another by the slighest movement of the cord, producing a scratching noise.

The steel cords overcame these difficulties and became great favorites. They had longer life, and when they opened they opened all at once. These, however, were not ideal because they were less flexible and contained rather high resistance in their conductors and were also a fire risk. The resistance of a steel cord is about 9 ohms for the tip conductor and 11 ohms for the ring conductor in a six-foot cord as compared to a resistance of less than one ohm in the tinsel cord.

Later, efforts were made to cut down the resistance of steel conductors by combining steel and copper in some form, but this was not an entire success, although they were used for some time in toll trunk circuits.

Circular on "Telephone Service" by Bureau of Standards.

Circular No. 112 of the United States Bureau of Standards on "Telephone Service" has just been published and may be obtained from the Superintendent of Documents, Washington, D. C., at 65 cents per copy.

The product which a telephone company sells is service but from an analytical standpoint the service as a whole must be divided into its elementary characteristics which are peculiar to the nature of the service and to the manner in which it is rendered. The primary object of this circular is to enumerate these elements and to explain how the grade of service is dependent upon each of them.

As some knowledge of the manner in which telephone service is rendered is a prerequisite for understanding a discussion of graded telephone service, the secondary object of this circular is to furnish the reader a sufficiently extensive description of modern telephone practice. This description is non-technical in character and, so far as operating methods are concerned, includes only those methods which are most essential. These are, however, so numerous that the greater part of the circular is given over to their consideration.

Service in general is considered in the introductory section while descriptions of the telephone plant and its operation are given in sections which respectively consider developments of the telephone art, equipment of manual systems, equipment of automatic systems, outside line construction, and telephone traffic. These are followed by the section on the principal elements of telephone service.

Attention is especially directed to the section entitled "Principal Elements of Telephone Service." Here are considered those service characteristics which are outlined in the determination of the grade of service and thus there is furnished a basis for future work along the lines of service standards.

The elements are considered in groups, each having common service relations, and the most important factors involved in each case are enumerated and their relations to the grade of service are explained.

A section on the subject of public relations has been included to cover those phases of telephone service which receive attention by regulatory commissions both federal and state.

Plant extensions, abandonment of service, physical connections, accounting, valuation, rates, rate schedules, contracts, collections, and discrimination have been considered. A conclusion is drawn regarding the subject of service standards.

The rapid and extensive development of the telephone industry is indicated by statistics given in the form of an appendix.

GREAT BRITAIN'S LONG DISTANCE SYSTEM.

(*Continued from page* 16.)

Office. Early in January, 1913, Mr. Pollock initiated an investigation of the relation which existed between cross-talk, and wire and wire, and wire and earth capacities in quad-core and multiple twin cables when tested in short lengths, and devised apparatus for making the capacity measurements with alternating current of telephone frequency with the necessary degree of convenience and accuracy.

Short lengths of cable were specially constructed with a great variety of different lays in the paired conductors, and it was shown that while certain selected lays gave favorable experimental results, the necessary symmetry in the spacing of conductors could not be obtained by cable manufacturers to ensure a sufficiently good balance of the various capacities between conductors and between conductors and earth.

An approximate formula was obtained for connecting the amount of cross-talk between circuits in the cable with the capacity relations of the conductors, and a systematic method was worked out by which the unbalances of capacity in one short length could be greatly reduced by selecting wires in contiguous lengths having nearly equal and opposite characteristics, so that the conductors when joined together would neutralize each other's defects. This plan only differed in degree and detail, but not in principle, from the method of balancing previously adopted by Messrs. Tremain and Martin.

In order to obtain the required degree of balance for loaded and superposed circuits it was found necessary to test every drum of cable of approximately 176 yards in length, instead of sections of approximately five miles, and preselect the wires for jointing at every 176 yards by inserting crosses as between core and core, in addition to crosses as between individual wires and pairs. The system of testing and selection is necessarily laborious and complex, and a number of the most able officers in the research section of the Post Office have contributed most valuable improvements, both to the mathematical theory and to the practical methods of cable balancing.[4]

The modern method of balancing underground cables which require to be loaded and to carry superposed loaded circuits was first applied to an underground cable in this country in 1913, when it became necessary to lay a composite telephone and telegraph cable between Leeds and Hull to replace the aerial wires which previously existed. This cable of approximately 52 miles in length was begun in June and handed over for traffic on November 23, 1913.

This cable is interesting, inasmuch as it involved the making of over 90,000 capacity tests under field conditions, and because every individual mile of the cable throughout the whole route was balanced to a very high degree of accuracy. The cable without any modification or adjustment was found suitable for working simultaneously, without cross-talk or disturbances of any kind, loaded physical telephone circuits, loaded superposed or phantom circuits, and high-speed Wheatstone automatic telegraph circuits.

The program of construction for 1914 included the provision of a main cable-duct route from London to Liverpool via Birmingham, and the first cable on this route was commenced in that year, completed as far as Birmingham in June, 1915, and extended to Liverpool in 1916.[5] The cable was designed to give 30 circuits between London and Liverpool, and 42 between London and Birmingham and Birmingham and Liverpool (see Appendix I).

The results obtained from this cable removed all doubts as to the future success of the underground trunk cable in relieving congestion on the aerial lines, but it soon became evident that the very success of the first cable had opened up some new problems.

The quality of service afforded by this cable in comparison with that previously given by aerial lines led to a rapid increase in traffic between the centers connected by the cable. Not only were the individual circuits more "silent," i.e. free from the background of extraneous noise usually experienced on long aerial lines, but the whole groups of cable circuits between the respective centers were more reliable; they were unaffected by the adverse weather conditions which so frequently interrupt aerial lines in this country. Whereas a loss of 10 to 15 per cent of working time was a common experience on long aerial lines, the loss on these cable circuits was nil.

On more than one occasion during the war period, when the Post Office engineering maintenance staff had been depleted to the utmost for service with the military forces, and interruption intervals on aerial line routes were unavoidably prolonged, the London-Liverpool cable saved the telephone trunk system from serious breakdown.

This was notably the experience after the extraordinary blizzard which caused so much havoc in March, 1916. The storm swept across the country in a direction northeast to southwest, and reached a force of 75 miles an hour over a belt of nearly 100 miles in width between the Wash and the Bristol Channel. It reached the east coast about 7 o'clock on the evening of March 27, and was accompanied by a heavy fall of snow.

Within little more than two hours practically every pole line inside that belt had been destroyed, and roads, railways and canals were blocked with the poles and wires thrown across them. It was an unparalleled disaster in the record of the telegraphic and telephonic services of this country.

The main telegraph cables from London to the North saved the situation so far as that service was concerned, and the London-Liverpool cable, with the spurs from Birmingham to Sheffield and Leeds, and from Liverpool to Manchester, enabled the engineers to patch up lines from London to all the important towns of the North Midlands and the North, and to keep them in telephonic communication with London at a time when such service was of vital importance.

Returning now to the consideration of the effects resulting from the success of this premier cable, it can be understood why, within two years of its completion, every available circuit had been allocated, and the question of providing a second cable arose. Three ducts had been laid along the route, this provision being in accordance with calculations of future requirements based on previous experience.

It was evident that unless some new development in telephone engineering intervened, the duct route would be filled within a very short period. Moreover, the desirability of extending the underground system further north than Liverpool was apparent.

The largest practicable main telephone cable has a diameter of about 2.9 inches and can contain copper conductors to a total weight of about 15,000 pounds per mile. Standard 176-yard lengths of this cable weigh about 2¼ tons net, and about 2¾ tons gross when drummed for transport. For direct service between two centers such as London and Liverpool, requiring lines having a transmission equivalent of 18 miles of standard cable (i.e. $Bl = 1.926$) between terminal test boards, such a cable will carry 25 four-wire cores or quads of conductors, providing a maximum of 75 circuits, including phantoms.

For through-switching purposes between the same points, circuits having a transmission equivalent between main test-boards of 12 standard miles (i.e. $Bl = 1.28$) are necessary, and on this basis a full-sized cable will carry 19 of 57 circuits, including phantoms.

In order to obtain the necessary quality of transmission for direct service bequads of conductors, giving a maximum

---

[4]Journal of the Institution of Post Office Electrical Engineers, vol. 7, p. 41. J. G. Hill: "The Loading of Underground Telephone Cables." Institution of Post Office Electrical Engineers, Professional Papers. No. 68.

[5]Journal of the Institution of Post Office Electrical Engineers, vol. 7, p. 32; and vol. 9, p. 130.

tween centers 400 miles apart, e.g. London and Glasgow, it would be necessary to use conductors of much heavier gauge, and a full-sized cable for such a service would carry no more than 12 quads, giving a maximum of 36 circuits, including phantoms, but it is not at all certain that such a cable would be a practical manufacturing proposition.

It appeared, therefore, that it would be necessary to increase considerably the capacity of underground duct routes in order to cope with the expansion of traffic which would follow on the extension of the underground system.

At this juncture, however, the solution of one of the fundamental problems of long distance underground telephony, namely, the construction of an effective telephone relay or repeater, seemed possible.

The conception of a repeater which could be inserted in a telephone circuit and fulfil the same functions as a repeater in a telegraph circuit is almost as old as the telephone itself. From the earliest days of the telephone art, many investigators had worked patiently on this problem, and the records of the British Post Office contain reports of long and patient trials of innumerable telephone repeater devices submitted by inventors from time to time.

Prior to the introduction of the three-electrode thermionic valve, these devices were invariably of the microphonic type, in which a sensitive microphone was attached usually to the reed or diaphragm of a telephone receiver. Seeing that the energy available in a telephone circuit for operating a repeater is of the order of a few microwatts, it seems almost incredible that the inventors of microphonic repeaters should have been able to design anything that would function as an amplifier of the minute currents of speech frequency, and the fact that several such devices have been actually used in commercial circuits with moderate success is sufficient testimony to the patience and ingenuity of the early workers.

Chief among these were S. G. Brown in this country and H. Shreeve in

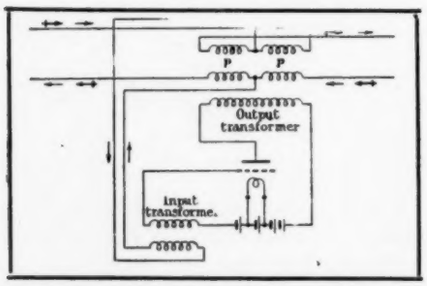


Fig. 2. Two-Way Telephone Repeater with Single Amplifier.

America. Mr. Brown's telephone relay is well known and was described in his paper read before the Institution in 1910. In the discussion on that paper, Mr. Kingsbury made an interesting reference to the work of Mr. Shreeve. In the light of our present knowledge and the possession of an almost perfect amplifier, it can be seen why the early attempts were not successful.

Our present knowledge of the laws of

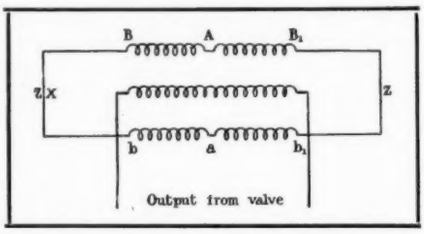


Fig. 3.—Line Circuit of Telephone Repeater Closed Through Two Equal Impedances.

the electrical transmission of speech over wires is due very largely to advances in physical science which, in themselves, are not specifically associated with telephony and which have preceded the development of the thermionic amplifier.

The introduction of the three-electrode thermionic tube completely changed the aspect of the telephone repeater problem. The early experiments of the Post Office commencing in 1913 were conducted with "soft" valves which, while not wholly suitable for the requirements of a commercial repeater, enabled engineers to make considerable headway in the design of repeater circuits, and emphasized the necessity for more complete measurements of the impedance characteristics of telephone lines over the whole range of speech frequencies.

The "soft" valve has now been superseded by the "hard" valve for all telephone repeater work (see Appendix II). The ideal thermionic valve for telephone repeater service should fulfill the following conditions:

(*a*) Its general design should be such that it can be manufactured in large quantities with uniform electrical characteristics.

(*b*) Its electrical characteristics should remain constant throughout its working life.

(*c*) Small variations in filament current due to the normal voltage-drop of the filament battery during discharge should cause no appreciable change in the amplifying power of the valve.

(*d*) Its amplifying factor, in association with its input and output transformers, should be practically constant over the range of speech frequencies, and over the required range of input voltage amplitude.

(*e*) The electrodes and their supports should be sufficiently rigid to ensure that no vibration from external sources affects the performance of the valve.

(*f*) Power consumption in the filament should be as small as possible.

(*g*) Long operating life.

The thermionic valve with its associated input and output transformers has only a unilateral action as an amplifier. For use in the ordinary two-wire telephone circuit it must be duplexed in order to transmit and amplify speech currents in both directions through the circuit. The duplexing is effected on the principle of the duplex telegraph relay, by the use of differential winding on the line side of the output transformer (see Fig. 2).

Speech currents from the up or down lines pass around the line windings, *P*, *P*, of the output transformer in series. The primary of the input transformer being joined across the middle points of the windings is a shunt on the line circuit, and a portion of the line currents

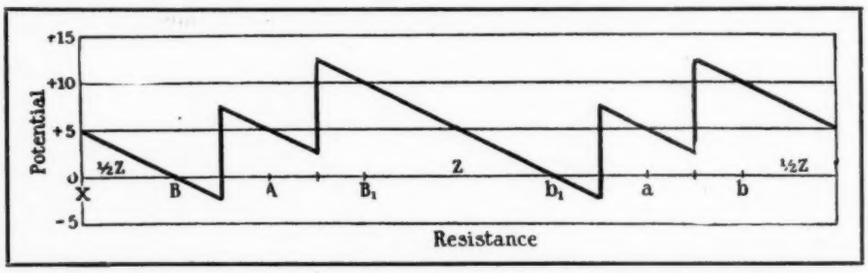


Fig. 4. Diagram Showing that "A" and "a" (Fig. 3) Are Equipotential Points.

passes through it and is amplified by the valve.

The amplified outgoing currents are transmitted to the up and down sides of the line in series, and if the two sides are electrically equal, the potentials at the middle points of the windings, *P*, *P*, are equal, and no part of the amplified current is fed back into the input circuit.

If the repeater circuit be represented by Fig. 3, it will be seen that in a properly-constructed transformer with an equal number of turns in all the windings *AB*, AB_1, *ab*, ab_1, the E.M.F. generated in all the windings by an alternating current flowing through the secondary will be equal. The impedances of the windings will also be equal. If the circuit be completed by the two equal impedances, *Z*, the circuit may be represented in straight-line form as in Fig. 4, the point *X* being taken as the starting point.

For the sake of simplicity, the E.M.F. of each winding is assumed to be concentrated at the center of the winding. The impedances have been represented to scale. Obviously the total voltage-drop in the circuit must be equal to the total E.M.F. in the circuit. A drop of five

volts has been assumed between the point X and the point B. There will be a corresponding drop between any two points having the same resistances between them.

The total on the scale chosen will, therefore, be 40, and each winding must,

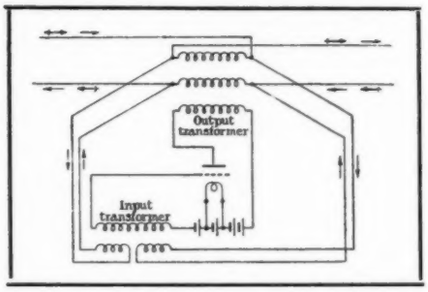


Fig. 5. Two-Way Telephone Repeater with Single Amplifier (Alternative Arrangement to Fig. 2).

therefore, produce an E.M.F. of 10 volts. It will be clear from an inspection of the voltage curve that, under the conditions given, the potential of A will be equal to that of a. This will hold good in any case if the circuit is symmetrical about these points so far as E.M.F.'s and impedances are concerned.

An alternative arrangement of the transformer windings is shown in Fig. 5. It will be noticed that if lines of dissimilar impedance be connected to the repeater shown in Fig. 2, the potentials at the mid-points of the line transformer will be unequal.

Consequently an out-of-balance current will flow through the input circuit and, if this current reaches a certain value, the amplifier will generate oscillations at a frequency determined by the electrical constants of the circuit. The resulting noise may be sufficient to make speech impossible between the terminals of the circuit, and in any case will reduce the transmission improvement of the repeater.

In the early days of microphone amplifiers this unbalance difficulty did not cause serious trouble, as the amplifiers were relatively insensitive; but since the introduction of the thermionic valve amplifier the unbalance difficulty has become more important. In fact, it may be said to be one of the chief difficulties in modern balanced repeaters.

In practice, the use of the simple differential repeater circuit shown in Fig. 2 is limited to those cases where the repeater can be inserted at the electrical center of a homogeneous and stable line circuit. This condition is obtainable generally only in well-constructed cables. In this country it is seldom obtainable on aerial lines, owing to the variations caused by our climatic conditions.

Under the best conditions of a cable circuit the simple differential repeater may be operated to give a transmission improvement equivalent to the suppression of 16 miles of standard cable in a circuit having an equated length of 30 miles of standard cable.

(To be concluded.)

War-Time Telephone Service Between England and France.

How telephone service was supplied between England and the Continent during the war period is interestingly told in a recent issue of The Telegraph & Telephone Journal.

During the early part of the war all the Anglo-Continental telephone circuits were reserved for the use of the Admiralty, the War Office and the War Cabinet, except only one circuit from the London trunk exchange to Paris and one to Boulogne. Even the use of these was restricted to calls on official business, either from government offices or from the offices of firms employed on government work.

The number of cables across the Channel was soon increased. Military exigencies are always for obvious reasons more rapidly satisfied than civil needs, and during four years of war no less than 15 additional channels of speech were provided between England and France, while 23 years had been required to bring into being the existing nine.

On the outbreak of war, most of the latter were, as already stated, set aside for communication between the War Office and the Base Offices and the Headquarters of the Expeditionary Force, but when the British Army moved into Picardy and Western Belgium after the battle of the Marne it became necessary to provide direct communication with that district also, and circuits were promptly run to the cable heads at the French coast towns. On the occupation of Belgium by the Germans one of the Anglo-Belgian cables was diverted to Dunkirk, but the older unloaded cable developed a fault and was not repaired during the course of the war.

Three additional circuits to Dunkirk were provided by a new cable from Dover in 1917 and used partly for Admiralty purposes and partly to afford communication with the headquarters of the Royal Naval Air Service in France in order that information and assistance might be obtained in connection with enemy air raids on England.

The difficulties involved in immerging cables in the English Channel in war-time under the constant threat of peril in the heavens above and in the waters beneath can readily be imagined, but the zeal and courage of the engineers and their assistants were always equal to the occasion. The following extract from a report of the engineer-in-chief in the laying of the Dunkirk cable gives some indication of the dangers involved:

"The landing of the shore end at Dunkirk gave rise to considerable difficulties owing to the rough but shallow water, in which even a barge was unable to work. As a consequence, sailors had to be employed to drag the cable over a bank for a distance of half-a-mile. An attempt was made to do this with 250 men but the number had to be increased to 850 before the operation could be performed.

"While this work was in hand an aerial combat between British and German aircraft was in progress overhead. The final operations in putting the cable through was the joining of the British and French sections in mid-Channel. The Mersey tried to make the joint last night but the weather was too boisterous. Fortunately it moderated sufficiently to enable the vessel to leave the harbor at 12:30 p. m. today, pick up the two ends, and join them together."

In December of the same year a cable containing three circuits (one superimposed) was laid between Dover and Sangatte and provided the naval and military authorities with additional circuits to Calais, and connected the war office with Versailles. By this time, the lines of communication in the north of France formed an extensive trunk wire system by means of which General Headquarters was not only directly connected with England via Calais, Boulogne and Dunkirk, but also with the various army headquarters and with Paris.

In May, 1918, two cables were laid between Dungeness and Audrecelles, providing six more circuits (two by superimposition) and were used chiefly in connection with the Dover patrol and the transport services. Thus not only were the governments in London and Paris placed in oral communication touch with each other, and the war office with its armies in the field, but, by degrees, all arms of the service were put in possession of the incalculable advantage of regular telephonic connection with England.

At the conclusion of the armistice, the requirements of the peace conference at the Astoria Hotel, Paris, were served by six direct circuits from London, three of which were obtained by utilizing existing lines and three by means of a further new cable between Dover and Sangatte, laid in November, 1918.

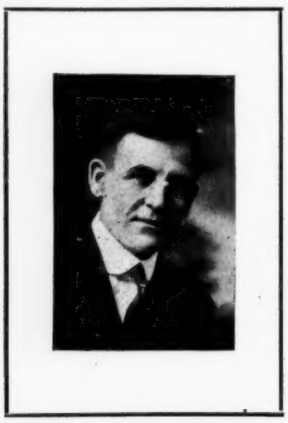
At this time there were 22 circuits working between England and France, nine of which terminated at Paris, four at Dunkirk, three at Boulogne, two at Calais, one at Versailles, two at General Headquarters, and one at the American headquarters in France.

One of the General Headquarters circuits was subsequently extended to Cologne until the re-opening of the public service to France. This constituted the only direct telephonic communication which has ever existed between England and Germany, although satisfactory speech trials were made in 1913 via Belgium between London, Cologne and Frankfort, and, later in the same year with Berlin.

Biographical and Personal Notes

Charles N. Bell, recently of the Northwestern Bell Telephone Co., Omaha, Neb., has joined the engineering department of the Tri-State Telephone & Telegraph Co., St. Paul, Minn.

Nineteen years ago Mr. Bell came into



Charles N. Bell Has "Come Through" By Sticking at It Constantly.

the telephone field on the business end of a long-handled shovel, digging holes for Jones & Winter, Chicago contractors, who were constructing the Independent telephone exchange at Wichita, Kans. He continued wielding shovels and pike poles for this concern while exchanges were rebuilt in Fort Worth, Gainesville and Denton, Texas.

In 1905 he went with the Western Electric Co., Chicago, in the equipment engineering department. From 1908 to 1910 he was switchboard foreman for the Des Moines Mutual Telephone Co., which was later absorbed by the Bell company. Mr. Bell then became equipment engineer for the Iowa Telephone Co.

When the United States entered the World War in 1917, Mr. Bell enlisted at once. He served 14 months in the 6th Field Signal Battalion in the United States and from August, 1918, to May, 1919, in France with the 39th Service Company, Signal Corps.

His desire for experience and travel lead him to join the Hoover Food Administration as a civilian, upon his discharge from the army in May, 1919, at Paris. His work with this committee consisted in installing telegraph and repeating stations in Paris, Italy, Serbia and Roumania.

While in Serbia Mr. Bell became acquainted with Prof. Michael I. Pupin, inventor of the Pupin loading coil, who obtained for him a flattering offer from the Serbian government to remain there to help restore telephone and telegraph service, but the lure of the United States and home was greater than the tempting offer. Mr. Bell says that there are great opportunities for American engineers in that country.

Two hobbies keep Mr. Bell occupied outside of his daily work—fishing and a brown-eyed woman. He married the brown-eyed woman, Miss Esther Carlsten of Minneapolis, Minn., June 30, 1921. At that time he was with the chief engineer of the Northwestern Bell at Omaha, Neb., but transferred to the Tri-State company immediately after his marriage.

Although married, Mr. Bell is still an ardent bass fisherman and very few opportunities to cast over one of Minnesota's famous lakes are passed up. He fishes the same way he works—with great interest. He is an Iowa man, having been born in Attica, in 1879, and is an Elk and a member of the American Legion.

Dorothy Gerlinger, supervisor at the exchange of the Ohio Bell Telephone Co.,

Telephone Girl Declared Most Beautiful in Ohio—She's a Supervisor at Fostoria Exchange.

at Fostoria, has been declared the most beautiful girl in Ohio.

A beauty contest was recently conducted throughout the state by the Cleveland Plain Dealer, in which more than 6,000 Ohio girls were entered.

When the contest ended, a trio of judges, artists of national repute, set to work on the photographs that had been submitted. Twenty girls, whose photographs were declared the best, were called to Cleveland and appeared before the judges.

It was unanimously decided by the judges that Miss Gerlinger was the prettiest girl in Ohio. She is dark, has an abundance of dark brown hair, and has a very sweet, modest expression. The judges said she was of the "Italian renaissance type."

The Plain Dealer gave Miss Gerlinger $5,000 in cash. For a week she appeared at the B. F. Keith theater in Cleveland and each afternoon and evening the amusement house was packed to the doors with Clevelanders anxious to see "Ohio's Prettiest Girl."

Miss Gerlinger has received an offer to appear in a moving picture with Thomas Meighan, idol of movie fans.

The contest winner is 21 years old. She was a switchboard operator at Fostoria for three years and has been a supervisor for one year.

August U. Bronder, of Chicago, a collecter for the Illinois Bell Telephone Co., is the first person in Illinois to receive the award of the Theodore N. Vail Medal.

Mr. Bronder received the medal for saving the life of Mrs. Albert Nagle. He called at the Nagle apartment on June 30, 1920, to make the regular collection from the telephone coin box. He heard groans coming from within the apartment but could not open the door. A weak voice informed him that a woman was locked in a closet and about to smother to death.

Making quick inquiries of other tenants, Mr. Bronder ran several blocks to the home of the landlord, where he secured a key and released the woman. She was by this time unconscious, but the collector

First in Illinois to Be Awarded Vail Medal—August U. Bronder.

applied first aid methods and, by the time the physician arrived, the woman had been revived and was out of danger. Her baby daughter had locked her in the closet and she was unable to open the door which had no knob on the inside.

Philadelphia's Automatic System

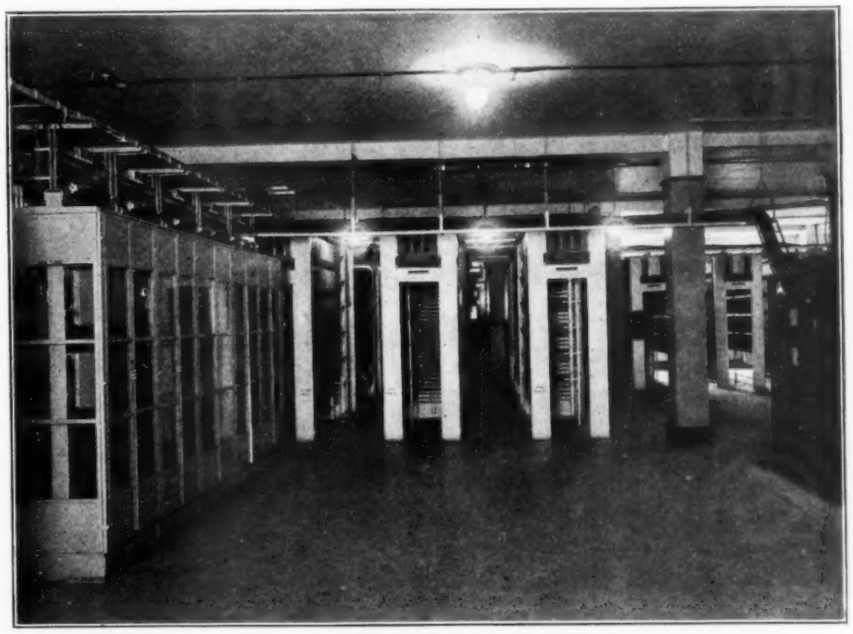
Some Details of New Automatic Plant of Keystone Telephone Co.—Numbering Scheme Planned for Future Growth—Rotary Secondary Line Switches—Method of Cross-Connection Between Primary and Secondary Switches

By H. E. Clapham

The successful conversion of the Keystone Telephone Co.'s plant at Philadelphia, Pa., was not accomplished by the mere manufacture and assembly of switchboard equipment. Only those that were actively engaged in the planning and extension of the undertaking are in a position to realize what it has meant, both to the Keystone company and Automatic Electric Co., as engineers and manufacturers, in the way of engineering studies, plant preparation and the planning of operating routines.

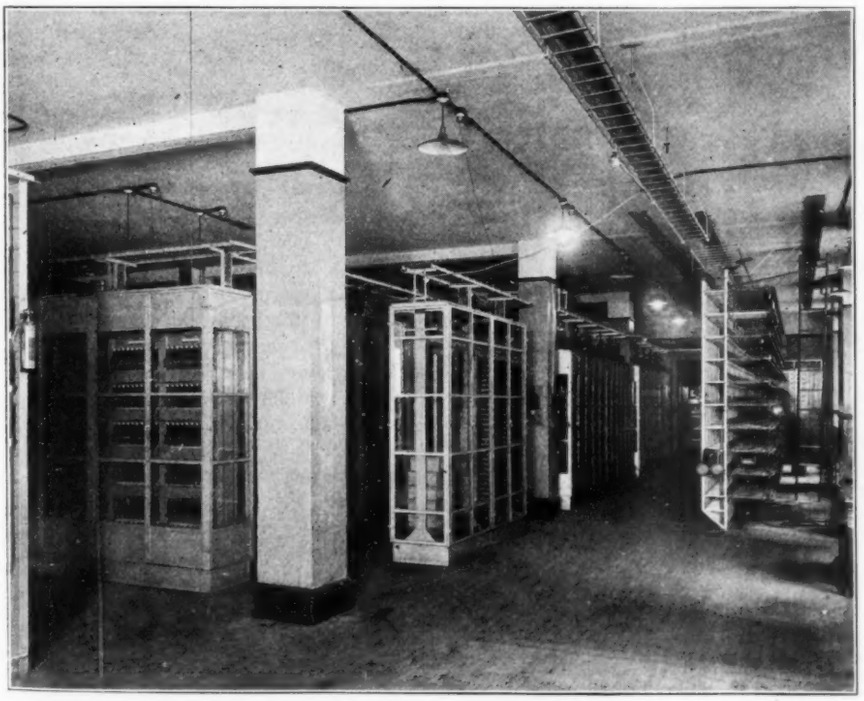
More than a year and a half elapsed since the work of conversion began, and it is chiefly to this long period of concentrated effort on the part of the manufacturers' engineering staff and the cooperation of that of the Keystone company that the smoothness of the cut-over and the subsequent efficient working of the plant are due.

One of the largest automatic networks in operation today, the Keystone system possesses some unusually interesting features. The automatic equipment serves some 47,000 stations in Philadelphia, the traffic being handled from six offices—Main, Race, West, Park, North and East. The system, as a whole, is of the five-digit type.



Switchroom of Main Office Showing Line Units and Trunk Boards.

Main office, in which the Keystone company's executive and general offices are located, is the largest, the switchboard having an installed capacity of some 7,000 lines. Race office, which is the next largest, is of importance in that it houses not only the automatic switchboard, but also all the manual desks which are associated with the local telephone system.



Main Office Switchroom Showing Main Frame and Rotary Secondary Line Switches.

The Keystone numbering scheme was planned with an eye to future growth as well as present distribution. The distribution of first selector trunks in each office is, in general, as follows:

First level: Reverting calls (118 - -). Fire and police (119 - -).
Second level: Trunks to main office.
Third level: Trunks to Race office and special service desks.
Fourth level: Reserved for contemplated "Broad" office.
Fifth level: Reserved for contemplated "South" office.
Sixth level: Trunks to Park office.
Seventh level: Trunks to West office.
Eighth level: Trunks to East and North offices through Park office local second selectors.
Ninth level: Trunks to Camden (N. J.) manual switchboard.
Tenth level: Trunks to long distance board at Race office.

The manual switchboards, including special service equipment, toll board and official P. B. X., are located on the fourth floor of the Race office building. The trunks to the special service desks are taken from the tenth level of the Race office second selectors, using a numbering plan as follows: Wire chief, Race 01; information, Race 02; complaint, Race 03; time, Race 04; Keystone Telephone Co., Race 06.

To reach the long distance recording operator, "0" is dialed. Each toll operating position is equipped with a calling device for setting-up calls for local sta-

tions incoming from long distance points. Each operator has access to trunks leading to toll second selectors in each office.

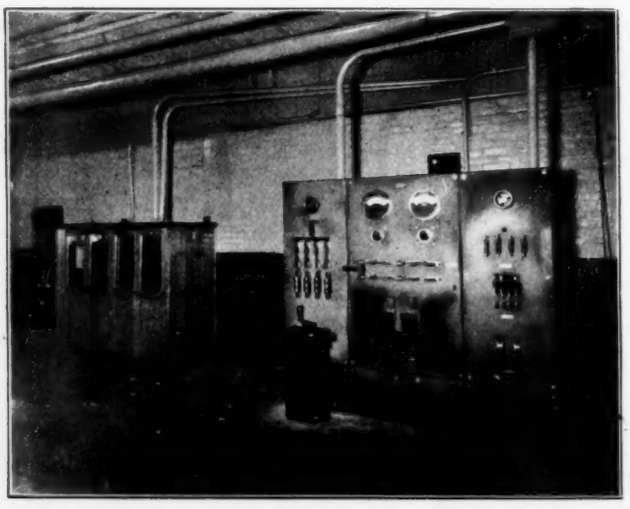
Each straight line and party-line unit is equipped with combination connectors which, although primarily for the use of the toll operator, may be taken by local subscribers when the regular connectors are all in use. The rotary (P. B. X.) units are equipped with local connectors as well as those that are exclusively for toll use.

The pay-station line traffic, individual and two-party, is handled in a very effective way. Each pay-station line is terminated on a line-switch (plunger type) and the originating pay-station traffic is trunked through rotary secondary line-switches to the pay-station desk at the Race office, where the pay-station operator sets up the call by means of the dial. Calls to pay stations are handled automatically in the usual way. The automatic distribution and handling of pay-station traffic has worked wonders in speeding up connections.

The majority of the local traffic, including all the party line and P. B. X. traffic, is handled on an unlimited service basis. Provision is made for message-rate individual line service where the subscriber prefers.

The party-line equipment in each office provides for four-party selective ringing, using harmonic ringers turned to 30, 42, 54 and 66-cycle current. Both two and four-party units are provided, although in general not more than two stations are equipped.

Previous to the installation of the harmonic ringers, the two-party lines were arranged on a divided ring basis, and subscribers on the same line desiring to talk called each other by dialing 11844.



Race Office Charging Panel and Counter-Cell Control Unit.

With the present harmonic ringers, reverting calls are made by dialing certain special numbers, of which party-line subscribers are properly pre-informed.

The power and signal equipment installed in each office is of the type customarily supplied for automatic offices, including charging machines, storage battery with counter cell voltage control (voltage limits automatically signaled) ringing, busy and tone machines, and harmonic converters for party-line ringing. Associated with each power board is the usual supervisory panel for controlling the alarm signals of the automatic switchboard.

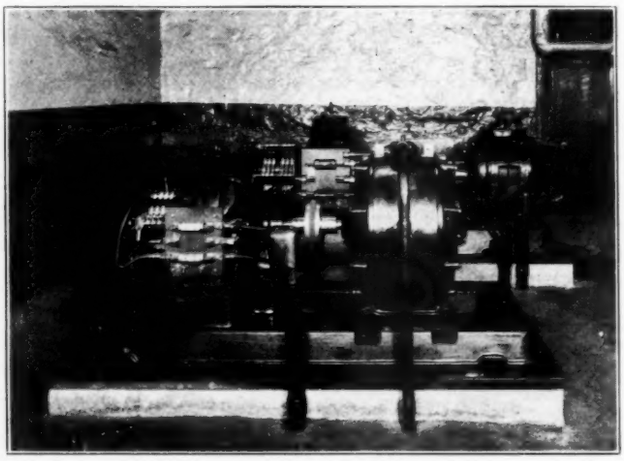
Apart from the magnitude of the system as a whole, perhaps the most interesting feature of the Keystone plant is the provision made for carrying the heavy traffic for which the two larger offices are especially noted.

This heavy traffic results from two principal causes. First, the lines of the Keystone system are centered largely within the business districts, which results in sharp and heavy peak loads during the business hours. Second, these exchanges serve an unusually high ratio of private branch exchanges. This combination of circumstances has necessitated a somewhat special treatment in the kind of equipment used and in the grouping of the switches.

To an equipment or traffic engineer an attractive feature of the installation is the use of secondary line switches of the rotary type, both for local and inter-office traffic distribution. This type of switch was decided on as being best able to meet the company's traffic demands, and the present smooth operation of the equipment is proving that the decision was justified.

As is generally known, the rotary type of line switch has a number of distinct advantages over the plunger type, chief among which are its greater trunk capacity and its simplicity of operation. Since each rotary switch has access to 25 trunks and each plunger type primary switch access to ten secondaries, an efficient cross-connecting scheme assures a first selector efficiency closely approximating that of a theoretic group of 250.

It is a noteworthy fact also that even during the busy hours of the morning when the traffic is heaviest, the great majority of the rotary switches take trunks entirely without motion of the wipers. In other words, the secondary first selector traffic distribution is so thorough that when a call comes to a rotary switch it is more often standing on the contacts of an idle trunk than a busy one.



The Charging Machines in the Race Office.

The scheme of cross-connection between the plunger-type primary switches and the rotary secondaries is similar to that used for plunger-type secondaries. As is customary, means have been provided for the prevention of loss of calls in case a group of secondary trunks become busy at any time.

This is accomplished by mounting over each secondary section a multi-contact relay which operates when all trunks of that section are taken. This relay serves to re-route all subsequent calls to other sections. The traffic distribution is so thorough, however, that this is seldom known to occur.

A description of this plant would be far from complete without a word of praise for those who were active in bringing the work of conversion to a successful conclusion.

The quiet, simple, yet dramatic moments of the transfer of service from manual system to the automatic tell but little of the many months of undivided effort that have been given to necessary preparation, both by the Keystone Telephone Co. and the installation force of Automatic Electric Co. under the leadership of H. P. Mahoney, assistant superintendent of installation and operation, and Austin Hill, chief installer.

There were many times and many places where friction might have developed, but did not, and the Keystone automatic network today stands as an enduring monument to the unfailing tact and courtesy and conscientious endeavors of those to whose co-ordinated efforts its present successful operation is due.

Actual Test of P&H Guaranteed Penetration Process poles before shipment. See plug below.

Best by Test

A SIMPLE TEST of poles treated by the P&H Guaranteed Penetration Process will prove conclusively our guarantee.

Test the poles treated by our process—prove to yourself that you are getting the full penetration. The more rigid the test, the better satisfied you will be.

Remember our guarantee is your safeguard. We urge you to test P & H Guaranteed Penetration Process poles.

Your interests will be safeguarded by demanding P&H Guaranteed Penetration Process poles. Don't be satisfied with any other.

P & H Guaranteed Penetration Process is the original guaranteed process and is produced only by the Page & Hill Co.

Write for Full Particulars.

PAGE & HILL CO.
Minneapolis, Minn.

BRANCH OFFICES:

Times Bldg., NEW YORK, N. Y.
717 Bryant Bldg., KANSAS CITY, MO.
19 So. LaSalle, CHICAGO, ILL.
1111 Carter Bldg., HOUSTON, TEXAS
311 Sumpter Bldg., DALLAS, TEXAS
1416 Starks Bldg., LOUISVILLE, KY.

Actual size photograph of plug removed from the guaranteed area of the pole shown above.

Originators of the P & H Guaranteed Penetration Process. Producers, manufacturers, and foremost in the Butt-Treatment of Cedar Poles.

This disc countersunk on the butt-end of every pole Butt-Treated by the P & H Guaranteed Penetration Process is your assurance of one-half inch penetration.

From Factory and Salesroom

Convention: Indiana, Indianapolis, September 13-14.

Switchboard Shipped to Philippine Island Companies.

Recent shipments of telephone switchboards to the Philippines indicate that the people of our island possessions are right uptodate when it comes to telephone service and equipment.

Two of the most notable recent consignments are magneto multiple switchboards of the type shown by the accompanying illustration and purchased by the Iloilo Telephone & Telegraph Co., Iloilo, and the Cebu Telephone Co., Cebu.

The board for the former company will be installed in Iloilo and replaces a three-position 450-line transfer board.

The new board is a four-position magneto multiple equipped for the immediate operation of 720 lines and has an ultimate capacity for 1,080 lines. The drop signals are of the electrically-restored type, manufactured exlusively by the Leich Electric Co., Genoa, Ill., claimed to make the operation of the board almost identical with that of common battery boards. Sixty-four cord pair equipments were provided, 16 in each position and were of standard high efficiency type, equipped with electrically-restored clear-out signals, repeat-trically-restored clear-out signals, etc.

The equipment for the Cebu Telephone Co. also consisted of a four-position magneto multiple board with 640 lines installed for immediate operation and provided with the same type of apparatus as above described. With this installation, there was furnished a set of 55 cells of 80-ampere hour capacity storage batteries, a motor-generator set for charging them and a special charging rheostat, making it possible to charge the battery as a whole, or in groups of 5 cells, at rates of current varying from 1 to 15 amperes.

Only five cells of the storage battery system will be utilized to supply current for the operation of the switchboard, the remaining portion of the battery is to furnish current for lighting the exchange, operating fan motors, etc.

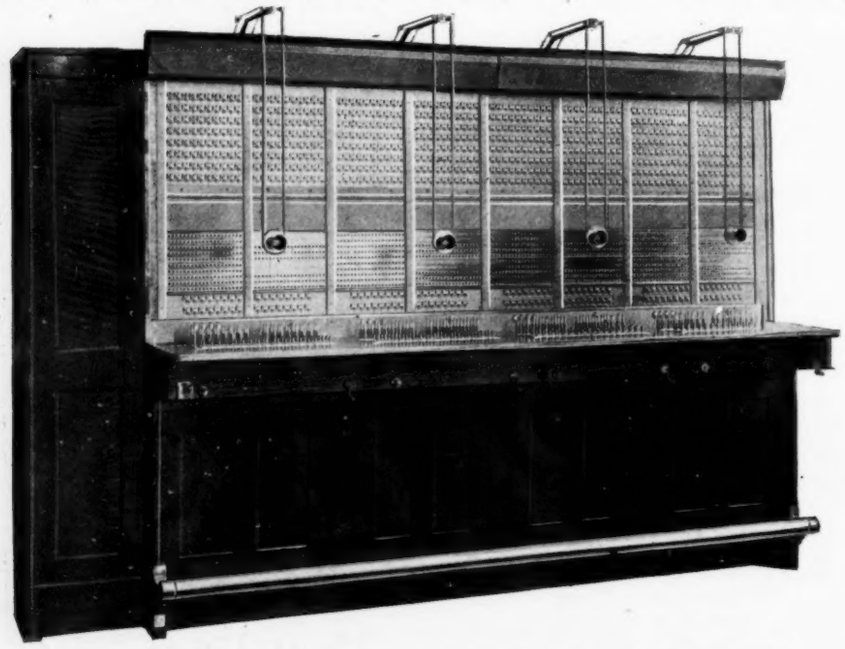
The switchboards are of the unit type and were completely assembled when shipment was made. All that will be required to place the boards in operation will be the connection of the line cables to the distributing frames and attaching of the battery leads to the proper terminals.

Due to the severe climatic conditions which switchboards in the tropics must withstand, nothing but micarta and bakelite insulation were used in the various parts and all coils were impregnated with an insulating varnish by a vacuum process and thoroughly dried in electric ovens.

Brass was used for all metal work in place of iron wherever possible and where iron was required, it was given special treatment to prevent rusting.

Complete arrester and distributing racks of the fuse and carbon block type were supplied with both boards.

These two installations were planned and furnished complete by the Leich Electric Co. of Genoa, Ill.



Type of Magneto Switchboard Shipped to Philippines by Leich Electric Co.

F. L. Baer of Automatic Appointed Assistant Chief Engineer.

Announcement is made of the appointment of F. L. Baer, since 1919 contract sales engineer of the Automatic Electric Co., as assistant chief engineer. Mr. Baer assumed his new duties on July 15.

Fred Baer Takes on Duties of Assistant Chief Engineer in Addition to Those of Sales Engineer.

Upon his graduation from Notre Dame University, Mr. Baer entered the employ of the Automatic company—in 1903. After the usual apprenticeship in the factory, he was engaged in installation work at various points. In 1907 he was made superintendent of equipment of the Bay Cities Home Telegraph & Telephone Co., at San Francisco.

During the years 1912 and 1913 Mr. Baer was with the Pacific States Telephone & Telegraph Co. and in 1913 went to Australia as resident engineer for the Automatic Electric Co. Upon his return to America in 1915, Mr. Baer was resident engineer in connection with automatic installations for the Tri-State Telephone & Telegraph Co. in Minneapolis and St. Paul. In 1918 he became sales engineer and in 1919 took charge of the contract sales engineering. Mr. Baer retains these duties in his new position.

Mr. Baer's experience in automatic telephone engineering and operation and with automatic networks, large and small, will enable him to perform his new duties in a most capable manner. He is well known in the telephone industry and has contributed some valuable literature

Exide BATTERIES

The fundamental value of Exide Batteries in the telephone field has been proven ever since the central energy system was established over 25 years ago. Today, the Exide is as modern in construction and design as the latest practical innovation in telephony; a fact attested by its almost universal use.

THE ELECTRIC STORAGE BATTERY CO.

Oldest and largest manufacturers in the world of storage batteries for every purpose

1888 PHILADELPHIA 1921

Branches in 17 Cities

Exide Batteries of Canada, Limited, 133-157 Dufferin St., Toronto, Canada

ROEBLING

TELEPHONE WIRE

Covered with the heaviest practical coat of spelter. Highest electrical and mechanical properties.

E. B. B, B. B. and STEEL GRADES

JOHN A. ROEBLING'S SONS CO.

TRENTON, NEW JERSEY

Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds.

4 Sizes Pat. Nov. 1900

Write for Samples

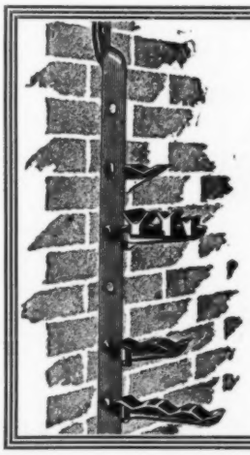
Blake Signal & Mfg. Co.

BOSTON, MASS.

CEDAR POLES

SHIPMENTS AS ORDERED

THE MAC GILLIS & GIBBS CO. MILWAUKEE WIS.



"The Cope"

Cable-Rack

Requires but 2 bolts. Arms are Self-Locking.

T. J. COPE

Underground Equipment and Tools

1620 Chancellor St., Philadelphia, Pa. 3

NORTHERN-WESTERN CEDAR POLES

A FULL ASSORTMENT OF SIZES
PROMPT SHIPMENTS ASSURED

T. M. PARTRIDGE LUMBER COMPANY

Lumber Exchange MINNEAPOLIS

NORTHERN **CEDAR POLES** WESTERN

BUTT-TREATING GUARANTEED GRADES

BELL LUMBER COMPANY, MINNEAPOLIS, MINN.

"NAUGLE" POLES

Plain or Butt Treated. Largest Stocks.

READY FOR IMMEDIATE SHIPMENT

NAUGLE POLE & TIE CO.

Main Office: 50 E. Madison St. CHICAGO

Use Automatic Lightning Arresters

The only **guaranteed** lightning protection in the world. End the fear of lightning. Save time and maintenance bills.

Fullmer & Avery Automatic Lightning Arrester Co., Illmo, Mo.

NORTHERN POLE and LUMBER COMPANY

POLE SERVICE

DULUTH MINNESOTA

White Cedar Poles

A SPECIALTY

Yards in Minnesota, Ontario, and Manitoba
Prompt and Satisfactory Service

CANADIAN CEDAR & LUMBER COMPANY, Limited

301 Electric Ry. Chambers Winnipeg, Manitoba.

on the automatic telephone in the form of papers and studies before engineering societies throughout the country.

Book Review.

E M F Electrical Year Book. First annual edition, 1921. Published by Electrical Trade Publishing Co., Chicago. Cloth, about 1,000 pp. (9 by 12 ins.). Price $10.

The first edition of what its publishers aim to make a very useful annual reference book of current information for and of the electrical industry has made its appearance. It comprises three leading features: Compilations of facts and figures about each branch of the industry, definitions of electrical and allied terms, and a classification of products made and used by the industry with listings of their producers. This last feature is the most prominent one of the book as regards number of topic and listings. All topics are entered alphabetically, the entire text being arranged as in an encyclopedia or dictionary so that it is very easy to find any item desired.

In the products and manufacturers' directory feature there are included over 2,900 classifications and sub-classifications of electrical and related products, each of which is first descriptively defined and followed by the list of its American and Canadian manufacturers. Each leading class of apparatus (such as generators, motors, batteries, switches) is preceded by a general article on principle, types, production etc.

Supplementing this feature are separate alphabetical company listings of over 4,900 manufacturers. A further type of entries in the products class consists of about 4,350 trade names which enable one to find readily the name of the manufacturer using each.

The dictionary feature includes, besides the definitions of the products referred to, definitions of several thousand electrical words, terms and abbreviations, also of magnetic, photometric, chemical and other terms closely related to the electrical.

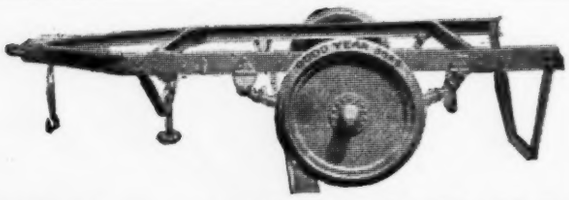
Among the numerous topics constituting the encyclopedia feature of the book are historical and statistical articles, reviewing the development and present status of the electrical industry as a whole and each of its principal branches, also similar articles on all important electrical applications. These include not only the better known electrical developments, such as the electric public utilities, but those on which information is not so readily available, for example, X-rays, electric ship propulsion, steam railroad elecrification, electric welding, wire and cable manufacture, raido communication, etc.

All the editorial work on the book was done under the general direction of Frank H. Bernhard, who for 14 years has been active on the editorial staffs of various electrical journals. Most of the technical topics were prepared by a staff of some 30 contributing editors, including college professors, electrical engineers and other specialists in their respective lines. These and other outside writers with the office editorial staff made a total of over 60 contributors to the book.

It is planned to revise the book completely and to add to it each year further industry information, definitions, products and manufacturers' listings. The book does not supplant the electrical periodicals, engineers' technical handbooks or students' textbooks. Its aim is declared to supplement all these by a carefully revised annual compendium of current facts and figures on the various electrical activities, of up-to-date definitions of electrical terms, and of classifications of products and their producers.

Practically every large industry has a year book containing a comprehensive trade directory of its products and manufacturers. The electrical industry now at last has this and more in the E. M. F. Electrical Year Book.

A complete stock of
KELLOGG TELEPHONES
TELEPHONE SUPPLIES
NORTHWESTERN ELECTRIC EQUIPMENT COMPANY
SAINT PAUL AND DULUTH, MINNESOTA



A $525 Government Trailer for Only $112.50

100 only to be sold. First come, first served.
Terms $25.00 cash with order. Balance on delivery.

One Trailer...$112.50 Two Trailers...$200.00

A real bargain, and opportunity for 100 telephone operators to add trailers to their service at a minimum cost. There is no additional charge, as the $112.50 price is F. O. B. St. Louis, Mo.

These trailers are brand new, and have never been used. The oversized solid rubber Goodyear tires are worth more than $90. The wheels, tires, springs and axles would cost over $350 alone.

SPECIFICATIONS

Wheels: Budd, double disc steel wheels.
Bearings: Timken roller bearings.
Axles: Chrome Vanadium steel axles. 1¾"x2½".
Chassis: Length over all—12¾ ft. Length of body space—9 ft., 3 inches. Width of body space—4 ft. 3 inches. (Springs can be overslung and body width increased.
Frame: Heavy channel iron frame, 5"x1¾".
Springs: Semi-elliptic, 60"x3" brass brushed, 11-leaf, underslung, giving a low center of gravity.
Capacity: 3000 lbs.; overload capacity, 50%.
Tires: 36x5, Goodyear, Goodrich and Firestone; solid rubber.
Color: Army olive drab.
Equipment: Heavy drop screw jack attached to frame for stabilizing in horizontal position when not in use. Heavy angle iron nonadjustable V-shaped brace on rear which can be dropped for stabilizing if needed. These two stabilizers fold toward the frame and are supported by chains attached to frame, when not in use. Also two anchor blocks on chains attached to frame, used for blocking wheels. Each trailer is equipped with two mud guards.

J. S. & E. E. Cuming

1011 Market St. **St. Louis, Mo.**

ORANGEBURG FIBRE CONDUIT

THE STANDARDIZED CONDUIT

WRITE FOR PARTICULARS—BOOK H

FIBRE CONDUIT CO.
ORANGEBURG N. Y.
NEW YORK CHICAGO BOSTON
SAN FRANCISCO NEW ORLEANS

Efficient Telephone Service

can be secured only by the use of efficient modern equipment. You will find such apparatus advertised in TELEPHONY.

Please tell the Advertiser you saw his Advertisement in TELEPHONY.